MODERN MECHANICS AND INVENTIONS

JULY 25¢

A DIRIGIBLE WITH WINGS
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My Idea Paid Me a Million

HOW TEN MEN DEVELOPED THEIR INVENTIONS

SEE PAGE 38

we have placed machinists, carpenters, masons, plumbers, railroad men, office clerks, farmers and even laborers in fine Drafting Jobs under this plan. Mail coupon for details of our remarkable offer.

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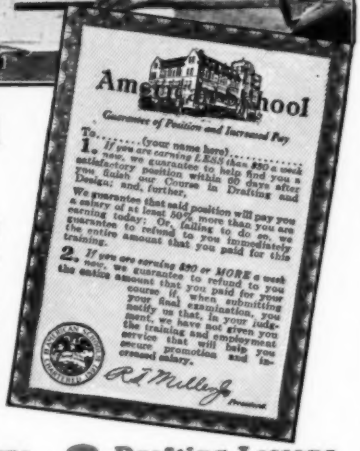
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VOL. II NO. III
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1929
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MODERN MECHANICS AND INVENTIONS

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Listed below are the members of the Modern Mechanics Board of Editors, all qualified by national repute to serve as authorities. They will gladly answer questions from readers concerning their departments. Address them in care of this magazine, Robbinsdale, Minn.

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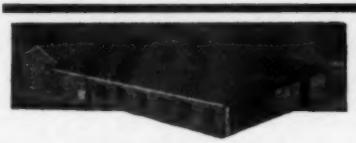

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—L. L. Cooke

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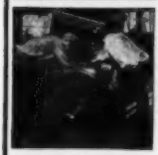

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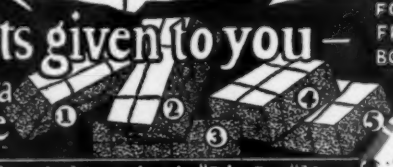

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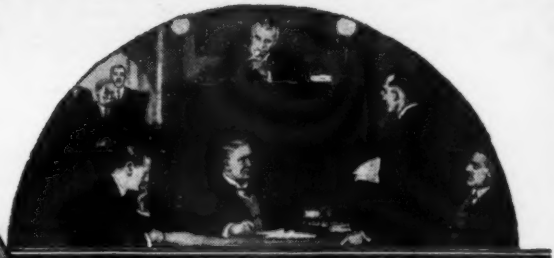

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What other profession offers such unlimited opportunities for advancement as can be found in the practice of law? It can lead you to earnings large enough to satisfy any normal ambition and it can lead you to fame and fortune. How far you go in this profession depends on your energy and ambition.

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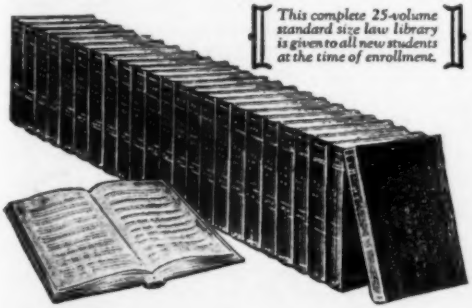

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SHOP MAILBOX

SUMMER is here! And with summer come all the outdoor sports which make life so well worth while—golf, tennis, motoring, sailing, fishing, camping, outboard racing, motorboating, and flying.

The editors during these summer months are presenting something for everybody interested in one of these sports. We have had experts in several lines pick out the salient points of their game. These are told in MODERN MECHANICS beginning with this issue. Tersely told, with the how and the why of the high points of many of these sports properly stressed, the first of these articles will be found on page 46—the story on "Mechanics of Plain and Fancy Diving," by James Nevin Miller. This fine article will give you information as to how champion divers develop their form and skill. It shows how you can do likewise. Other articles of a similar nature will follow and we'll wager they will show you things about your sport-hobby that you never knew before!

Sam Brown Makes a Hit

One reader writes:

Your story by Sam Brown called "The Tricks of the Strong Man" hit the spot with me. I was mighty interested to know that lots of the super strength tricks were merely hoaxes. Give us some stories on magic.

Of course, all the usual good how-to-build features will be along in the due course of time. Next month, for instance, carries an article by Sam Brown wherein the doughty Ohioan shows, as illustrated with photos, how to make a simple sailing rig for your canoe. Then too the further details of the wonderful little Lincoln Sport biplane will be shown. For either of these features you would have to pay any designer handsomely. MODERN MECHANICS in line with its policy of surrounding the best features to be had in every field of fun, offers these together with other unusual news features.

We are in receipt of a letter from Edward Schneider, who built a motorcycle engine driven sled last winter along the lines suggested by Gilbert Mickelson in his article in the February issue. He says in part:

. . . Received both your letters and am glad to have a better knowledge of the Lawrence motor. I had the impression that it was an opposed motor and much smoother running than the rest . . . My sled can have pontoons put on and can be used as a boat . . .

The reference to the Lawrence motor is one which we have had many inquiries on. The Lawrence motor is an opposed cylinder job, but has a single throw crank so that the cylinders fire at odd and sundry moments. The conversion of these motors into a smooth running job which will not shake the average sportplane to pieces involves the substitution of the two throw for the single throw crank.

Lawrence Engine Data

In this connection, speaking of motors, we have in process an article on the construction of the three-cylinder motorcycle radial which was put on the market after MODERN MECHANICS readers showed such an interest in the design run in the December issue. This will be along in the early fall months. Don't miss this one, gang!

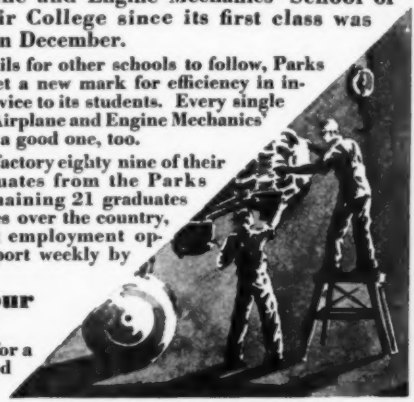
110 GRADUATES
All in Good Positions

Parks Air College has a corps of 54 instructors, eleven buildings with a floor space of 60,000 square feet and a total investment of more than $350,000.00

That is the amazing record established by the Airplane and Engine Mechanics' School of Parks Air College since its first class was graduated in December.

Blazing new trails for other schools to follow, Parks Air College has set a new mark for efficiency in instruction and for service to its students. Every single graduate of the Parks Airplane and Engine Mechanics School is in a job—and a good one, too.

In one particular airplane factory eighty nine of their valued employes are graduates from the Parks Mechanical School. The remaining 21 graduates are working in different factories over the country, having selected some of the best employment opportunities that come to Parks Airport weekly by wire and by mail.



As a Parks Graduate Your Future Is Assured

A position in an airplane factory is only the start for a man of ambition. After that come the high priced excutive positions in transport companies, mail lines, photographic work, mapping, prospecting, as airport managers, and in private flying. *Aircraft mechanics, riggers, inspectors, designers, draftsmen, instrument makers, metal workers, woodworkers,* and many other highly paid men are needed. You can choose the type of work you like best--and make big money.

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Decide now to come to the largest and most completely equipped non-military air college in the world. Here, right at this busy metropolitan airport, you will be trained with the very best equipment. You will work on Whirlwind, Liberty, Caminez, Velie, Hispano-Suiza, OX5, and other famous engines. You will actually build airplanes. The science of *Aerodynamics, complete shop practice, welding, brazing, metal and wood working* in fact, everything that you need to know in order to command a big money job, will be taught you in an easy, interesting way.

Come to Parks

Aviation executives want the high type men turned out at Parks. The whole story of Parks Air College, the training courses, and student life is fully described in our illustrated booklet. Fill in the coupon now and get your copy by return mail.

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Further Letters from Readers Taken at Random from the Shop Mail Box

From down in N'Orleans we get word that Carl Bixner is building one of the Northrop type gliders, and has the wing panel finished. Mr. Bixner intends to use an auto towing the glider to launch it. The glider plans were popular as ever, and are making more friends for MODERN MECHANICS magazine.

Then again, an interesting letter from an entirely different angle showed up the other day. A clergyman in New York state wrote, in part:

Considerable friendly argument has come to the fore here among ardent readers of Battle Stories Magazine (Modern Mechanics companion in the fiction field). What we want to know is, what was the fastest airplane during the war and was the Fokker the best plane in the war or not? We should like to know . . .

Speed of War Planes

This query was answered by Major H. H. Arnold, MODERN MECHANICS aviation editor, as follows:

I can give you the following as authentic: In 1916 the Fokker was the fastest plane on the front. In 1917 conditions changed. It must be recognized, however, that the value of a pursuit plane is not directly proportional to its speed. The best pursuit plane is the one which combines maneuverability, speed, climbing ability, high ceiling and maximum diving speed. Thus the mere fact that one plane was faster than another means nothing in aerial combat.

The S E-5 was not as fast as the Fokker but could out-maneuver and dive faster. On the other hand the Fokker could outclimb the S. E. The Spad was faster and could out-maneuver the Fokker but did not have as high a ceiling and could not attain as high a diving speed.

The speeds of the pursuit planes used during 1916, '17 and '18 were as follows:

Fokker Tri-plane	**118 mi. hr.**
Fokker D-VII	**121 mi. hr.**
Nieuport	**120 mi. hr.**
S E - 5	**119 mi. hr.**
Spad	**124 mi. hr.**

Certain planes of each of these types were faster than others but the above figures are those generally accepted as BEING the best average performance.

Yours,
H. H. ARNOLD.

There you have the authentic information, folks. It is interesting to compare the top speeds of the fastest World war planes with the 170 m.p.h. performances of present-day Boeing fighters of Uncle Sam.

IN CONNECTION with the subject of aviation, let us mention that all indications point to a wonderfully successful contest in the "Win Your Wings" Contest. The calling of airplane pilot is one well worth any young man's time, as witness what the General Manager of the National Air Transport of the United States says:

"Young men might well consider the calling of airplane pilot," said Colonel Henderson. "First class men are always in demand. Good pilots are well paid. Our men average at least $100 a week. Few of them are in the air more than five hours a day four days a week."

Last year about 2,000 planes were built in the United States, but the number built this year will show a 150 per cent increase, probably reaching a total of 5,000. Next year 10,000 will be built—possibly 15,000. Each of these planes needs a pilot. Where are they coming from?

Mechanics of Golf

From Dubuque, Iowa, comes a letter calling for some information on the principles of golf. Mr. Boothby says:

Modern Mechanics,
Editorial Dept.,
Dear Sirs:

Modern Mechanics ought to be the magazine to show the why of some of these baffling strokes we try to master in golf. So many people are playing the game now that I believe a mechanical interpretation of the skill behind the sport would be mighty interesting.

JAMES BOOTHBY.

This letter interested us inasmuch as it came in while the August contents were being considered, and an article by a well known author, graphically falling in line with our sports series, was on the table. You golfers who read MODERN MECHANICS, be on the lookout for this story—improve your form!

The model makers who read MODERN MECHANICS seem to be increasing with every issue, if we are to believe the trend as indicated by the fan mail which shows up at the editorial offices in Robbinsdale. Especially popular are the articles on home workshop and the boys workbench type. And maybe the airplane model makers aren't busy! For these readers we have in store such treats as the model seaplane article which appears in this issue.

Let This famous WORLD-WAR FLYER Teach You

Major Rockwell is a famous world war flyer, decorated at the front with the Legion of Honor and the War Cross. As a member of the dare-devil French Lafayette Escadrille, he spent hundreds of thrilling hours in the air. Since the war he has devoted himself to teaching men eager to get the right start in Aviation. Let him train you for this great new industry as only a veteran world war flyer can train you—and your future in aviation is assured.

Major R·L·Rockwell AIR CORPS U·S·R·

*[Member of the Daring Lafayette Escadrille
Chevalier of the French Legion of Honor]*

Invites You to Join Him in AVIATION

Thousands of Big Pay, Fascinating Jobs, on the Ground and in the Air, are Begging for Trained Men - NOW -

MAN—now you can get into AVIATION easily and quickly! Now you can take your place in the most thrilling, fastest growing industry in the world! Break away from low pay and humdrum work. Aviation is begging for trained men now—mechanics, builders, flyers—at $50 to $250 a week. In this new, uncrowded field of adventure and big pay a place is waiting for you. Let me prepare you at home—in your spare hours, to be a successful air man. Let me give you in a few short months the store of practical aviation experience it took me many years to get. Let me prepare you for one of the thousands of big pay jobs. With my training, many men are now earning three and four times their former incomes. You can do the same. I'll not only train you at home—I'll also help you find the job you want after you graduate. Aviation is the game red-blooded fellows are flocking into. It is growing faster than the automobile or radio industry. Now—on the threshold of aviation's greatest development—is the time for YOU to act. Rush the coupon to me for FREE copy of my famous book. Every page will thrill you.

ACTUAL FLYING to GRADUATES in Dayton, where Aviation was Born

My practical home study course prepares you to fill any aviation ground job in America. **You need no further training.** It also prepares you to FLY. Come right along to Dayton—the cradle of aviation and the home of the Wright Brothers and Wright Field. Come here and get your **actual flying** at one of the world's finest and best equipped air ports. The mail service and the passenger lines are waiting for you. You can get into aviation quickly. You need no previous education or experience. Get the facts—and my remarkable tuition offer.

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The CONSULTING EDITOR

From time to time letters reach the editors which are of a technical nature, but which are of widespread interest and occur to more than one reader at a time. Occasionally these will be answered in this department by the Consulting Editor.

EVERY so often one of the articles in MODERN MECHANICS occasions so much reader interest that considerable inquiry results. At this time I am answering some of the queries that have been most numerous of late. The first one generally runs like this:

What do you think of using the Lawrence engine in my light plane. I am told that it is a fine engine.

The truth of this matter you can answer for yourself when you realize that the Lawrence engine is not a true opposed motor and needs a double throw crank to make it opposed. The cylinders are opposed, but the crank is single throw. Unless redesigned and rebuilt, I do not recommend them.

FREQUENTLY we receive inquiries asking for the name of the manufacturer of an article which has been illustrated in MODERN MECHANICS. Generally we can supply this information, but frequently, where the picture is an imported one, we can only recommend inquiry from the point where we secured the picture. We are always glad to co-operate with readers.

Another type of inquiry deals with the re-hashing of designs for model engines and airplanes which are published in the magazine. Never change a designer's plans as much as a fraction of an inch. His judgment and skill have proportioned the sizes of parts with a thought to their strength and function. To change them is like painting the lily.

Mr. Lewis Klein, of Detroit, Mich., writes:

Where can I get good books on the building of models? I am extremely interested. I want to know how to use the tools. Please inform me.

We recommend the book by Raymond Francis Yates, sometime editor of Everyday Engineering Magazine, now no longer published. The name of Mr. Yates' book is "Model Making" and it can be secured from the Norman W. Henley Publishing Co., 2 West 45th St., New York.

A WORD of advice might be interjected here concerning the building and testing of the several model engines which have appeared from time to time in MODERN MECHANICS.

First, with regard to the flash steam engine by Gus Adelbert Deckert, which appeared in the May issue of the magazine. By flash steam is meant that produced in a flash boiler, which operates as follows: The boiler is of the tubular variety, of single tube from start to end. The tube is coiled in a flame and the water to be vaporized is passed through it. The water, upon hitting the hot coil is immediately "Flashed" into steam, and hence the name is taken from the method of obtaining the steam to run the plant with.

Second, as to the method of starting small gasoline engines. The engines which have appeared in the magazine to date are of the two-cycle type. This means that the gasoline mixture must be right, the timing right and that there is a spark. Then the motor will have to run.

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There are jobs for Draftsmen in all of these industries and in hundreds of others.

Aviation is expanding to enormous proportions.

Electricity is getting bigger every day.

Motor Bus building is becoming a leading world industry.

Building of stores, homes, factories and office buildings is going on all the time.

No structure can be erected without plans drawn by a draftsman. No machinery can be built without plans drawn by a draftsman.

I train you at home, in Drafting. Keep the job you have now while learning drafting.

I will train you in drafting right where you are in your spare time. I have trained men who are making from $3,500.00 to $9,000.00 a year. There is a big future for draftsmen because you plan and supervise the work of others, or you go into business for yourself. Get started now toward a better position, paying a good, straight salary, the year around. Comfortable surroundings. Inside work.

Earn As You Learn

I tell you how to start earning extra money a few weeks after beginning my training.

Employment Service

After training you I help you to get a job without charging you a cent for this service. Employers of Draftsmen come to me for men because they know that Dobe Trained Men make good as they have learned drafting by actually doing the work themselves, in a practical way. Employers know they are not taking chances on men trained by me.

Money-Back Agreement

I train you at home under a positive Money-Back Agreement. If my training does not satisfy you after you have finished, you get every penny back.

Age or Lack of Education, No Drawback

Previous experience is not necessary. You do not need to be a college man or high school graduate.

Help As Long As You Need It

As my student you can write to me any time you want to and as often as you like and I will give you help on any subject pertaining to draftsmanship. I will advise you about jobs, extra work, fees and how to make extra money.

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Mail this coupon, at once. Get "My Pay Raising Plan" and "Successful Draftsmanship". Both of them point the way to Success. You owe it to yourself to find out what a big opportunity there is in practically all industries, for Draftsmen. These two books are Free. They come to you post paid. Mail the Coupon for them TODAY.

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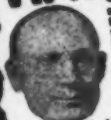

and give you a steady income for the rest of your life, if you'll take care of my business in your locality. No experience needed. Full or spare time. You don't invest one cent, just be my local partner. Make $15.00 a day easy. Ride in a Chrysler Sedan I furnish and distribute teas, coffee, spices, extracts, things people eat. I furnish everything, including world's finest super sales outfit containing 32 full-size packages of highest quality products. Lowest prices. Big, permanent repeat business. Quality guaranteed by $25,000.00 bond. With person I select as my partner, I go 50-50. Get my amazing offer for your locality. Write or Wire

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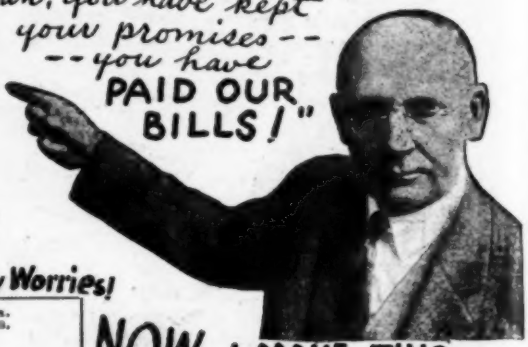
AND 20,000 MEN AND WOMEN HAVE FOUND THAT I MEANT WHAT I SAID

Since I first made this announcement of my amazing new plans, 20,000 good honest men & women have joined me. I made them my partners & went 50-50 with them. They say, "Van, you have kept your promises -- -- you have PAID OUR BILLS!"



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Wilkes Barre, Pa.
November 2, 1932.

C. W. Van DeMark, Pres.
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Dear Van:

I feel that I should tell you something of just how I feel about the wonderful treatment you give your Partners. Of course, you always go 50-50 in profits, but besides that, You take a great deal out of your own share to give to your Partners.

It is an easy matter for anyone of your sales representatives to make $15.00 a day, clear money. I have made $15.33 in two hours in one afternoon on personal sales in my territory.

You have presented me with $1457.00 worth of gifts, checks and prizes, in addition to the commissions that I have made on my sales. After I received the Piano that you sent me, I had a piano manufacturer come to my house and he immediately appraised it as being worth $1400.00 at retail.

In addition to this, you have given me clothing, bonus checks, table covers and numerous other beautiful and valuable prizes. I consider you the most generous, straightforward, fair and considerate sales manager and Partner that I have ever been associated with. You have assisted me in obtaining an additional musical education.

Do you wonder that I am thankful?

Very truly yours,

Wilbur A. Skiles

Wilbur A. Skiles

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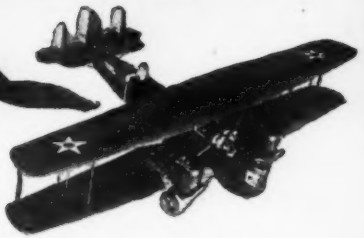

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I HAD never been called on to speak before. But the chairman had said: "Oh, it's easy, you won't have a bit of trouble. Just talk naturally." The minute I was on my feet I began to realize that speaking was a lot more difficult than I had expected. Everyone appeared to be bored and hostile. Suddenly I noticed two of the members whispering and laughing. For an instant I almost lost control of myself and wanted to slink out of that room like a whipped cur. But I pulled myself together and made a fresh attempt to get started when someone in the audience said, "Louder and funnier!" Everyone laughed. I stammered a few words and sat down!

And that was the way it always was—I was always trying to impress others with my ability — in business, in social life, in club work — and always failing miserably. Why couldn't I talk easily and fluently like other men talked? Often I saw men who were not half so thorough nor so hard working promoted to positions where they made a brilliant showing — not through hard work, but through their ability to talk cleverly and convincingly — to give the appearance of being efficient and skillful.

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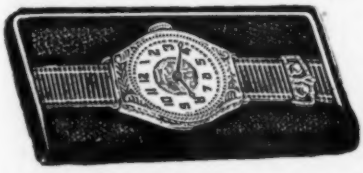

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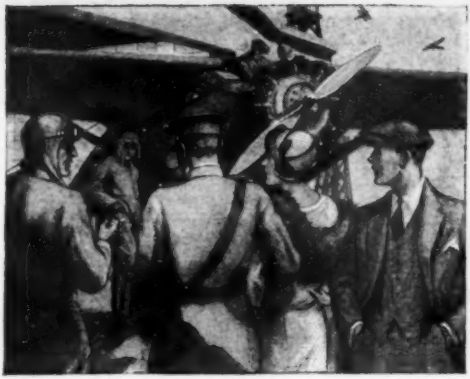

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*Based on the combined experiences of F. B. Englehardt, Chattanooga, Tenn., A. F. Thompson, Sioux City, Iowa, L. H. Lundstedt, Chicago, and many others.

Caught in a Rut

I wonder I put up with it as long as I did! Every day was filled with nothing but deadly routine and monotonous detail. No freedom or independence. No chance to get out and meet people, travel, nor have interesting experiences. I was just like a cog in a big machine with poor prospects of ever being anything more.

Long, Tiresome Hours

Every hour of the day I was under somebody's supervision. The TIME-CLOCK constantly laid in wait for me—a monument to unfulfilled hopes and dying ambition. Four times a day, promptly on the dot, it hurled its silent challenge at my self-respect, reminding me how unimportant I was and how little I really COUNTED in the business and social world!

Low Pay

Paid just enough to keep going—but never enough to enjoy any of the GOOD things of life every man DESERVES for his family and himself. Always economizing and pinching pennies. Always wondering what I would do if I were laid off or lost my job. Always uncertain and apprehensive of the future.

Desperate

Happened to get a look at the payroll one day and was astonished to see what big salaries went to the sales force. Found that salesman Brown made $200 a week—and Jenkins $275! Would have given my right arm to make money that fast, but never dreamed I had any "gift" for salesmanship.

A Ray of Light

Stumbled across an article on salesmanship in a magazine that evening. Was surprised to discover that salesmen were made and not "born" as I had foolishly believed. Read about a former cowpuncher, Wm. Shore of California, making $525 in one week after learning the in-and-outs of scientific salesmanship. Decided that if HE could do it, so could I!

The Turning Point

My first step was to write for a certain little book which a famous business genius has called "The MOST AMAZING BOOK EVER PRINTED". It wasn't a very *big* book, but it certainly opened my eyes to things I had never *dreamed of*—and proved the turning point of my entire career!

What I Discovered

Between the pages of this remarkable volume, I discovered hundreds of little known facts and secrets that revealed the REAL TRUTH about the science of selling! It wasn't a bit as I had imagined. I found out that it was governed by simple rules and laws that almost ANY man can master as easily as he learned the alphabet. I even learned how to go about getting into this "highest paid of all professions". I found out exactly how Mark Barichievich of San Francisco was enabled to quit his $8 a week job as a restaurant-worker and start making $125 a week as a salesman; and how C. W. Birmingham of Dayton, Ohio, jumped from $15 a week to $7500 a year—these and *hundreds* of others! It certainly was a revelation!

Employment Service

Furthermore, I discovered that the National Salesmen's Training Association, which published the book, also operates a most effective employment service! Last year they received requests from all over the U. S. and Canada for more than 50,000 salesmen trained by their method. This service is FREE to both members and employers and thousands have secured positions this way!

Making Good At Last!

It didn't take me long to decide to cast my lot with N. S. T. A.—and after a few weeks I had mastered the secrets of Modern Salesmanship during spare time, without losing a day or a dollar from my old job. When I was ready, the Employment Manager found me over a dozen good openings to choose from—and I selected one which paid me over $70 a week to start!

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Right now the book—"The Secrets of Modern Dynamic Salesmanship" — which banished all my fears and troubles and showed me how to get started on the road to success and independence—will be mailed as a gift to any ambitious man, absolutely FREE. And since there is no obligation, why not see for yourself what amazing facts it contains! Just mail the coupon now—for there is no better way in the world to invest a 2-cent stamp! I KNOW!

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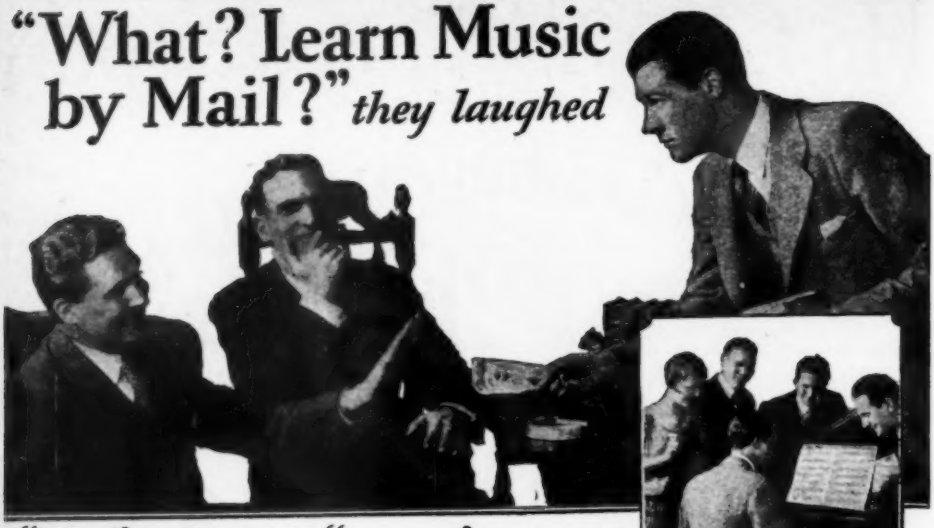
"What? Learn Music by Mail?" *they laughed*



"Yes," I cried, *"and I'll bet money I can do it!"*

ONE day after lunch the office crowd was in the recreation-room, smoking and talking, while I thumbed through a magazine.

"Why so quiet, Joe," some one called to me. "Just reading an ad," I replied, "about a new way to learn music by mail. Says here any one can learn to play in a few months at home, without a teacher. Sounds easy."

"Ha, ha," laughed Fred Lawrence, "do you suppose they would say it was *hard?*"

"Perhaps not," I came back, a bit peeved, "but it sounds so reasonable I thought I'd write them for their booklet."

Well, maybe I didn't get a razzing then! Fred Lawrence sneered: "The poor fellow *really* believes he can learn music by mail!"

"Yes, and I'll bet money I can do it!" I cried. But the crowd only laughed harder than ever.

During the few months that followed Fred Lawrence never missed a chance to give me a sly dig about my bet. And the boys always got a good laugh, too. But I never said a word. I was waiting patiently for a chance to get the *last* laugh *myself.*

My Chance Arrives

Then came the office outing at Pine Grove. After lunch it rained, and we had to sit around inside. Suddenly some one spied a piano in the corner. Fred Lawrence saw a fine chance to have some fun at my expense.

"Ladies and gentlemen," he cried, "our friend Joe, the music-master, has consented to give us a recital."

That gave the boys a good laugh. Some of them got on either side of me and with mock dignity started to escort me to the piano.

"Play 'The Varsity Drag'," shouted Fred, thinking to embarrass me further. I heard a girl say, "Oh, let the poor fellow alone; can't you see he's mortified to death?"

The Last Laugh

I smiled to myself. This was certainly a wonderful setting for my little surprise party. Assuming a scared look, I began fingering the keys, and then . . . with a wonderful feeling of cool confidence . . . I broke right into the very selection Fred asked for. There was a sudden hush in the room as I made that old piano talk. But in a few minutes a fellow jumped to his feet and shouted, "Believe me, the boy is *there!* Let's dance."

Tables and chairs were pushed aside, and soon the whole crowd was having a whale of a time. I played one peppy selection after another until I finished with "Crazy Rhythm," and the crowd stopped dancing and singing to applaud me. As I turned around to thank them, there was Fred holding a tenspot right under my nose.

"Folks," he said, "I want to apologize to Joe. I bet him he couldn't learn to play by mail, and believe me, he sure deserves to win the money!"

"Learn to play *by mail?*" exclaimed a dozen people. "That sounds impossible! Tell us how you did it!"

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Sated with the hum-drum work in the hangars, a grease-monkey yearned for the thrills and danger of battle in the clouds. His adventures are told in

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By BENGE ATLEE

in the JULY

Jay Lucas has written another flashing novel of the West he loves—"The Killers of Hat Cross Range"—which begins in this issue . . . Jay J. Kalez contributes a tale of crime and horror in "The Overbluff Murder Mystery" . . . Then there is the stirring conclusion of H. Bedford-Jones' great novel, "The Buckaroo From Texas" . . . and stories by H. Omar Barker, Sanford Jarrell, L. Paul, Lemuel de Bra, Sewell Peaslee Wright, Raoul Whitfield, Laurence Donovan and Chester L. Saxby.

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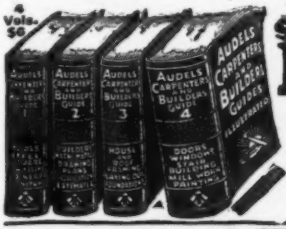

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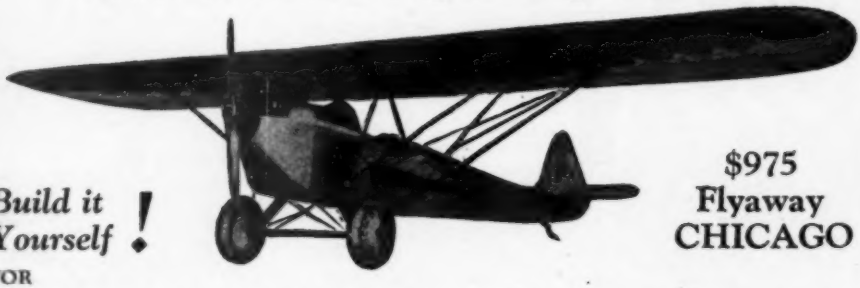

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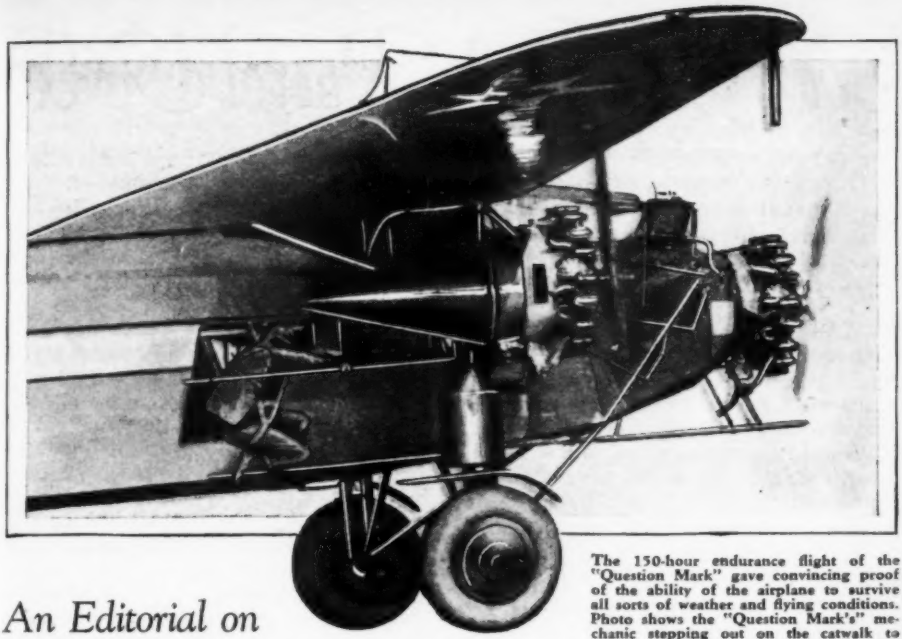
2. EVENTUALLY, EARTH AND MOON WILL REVOLVE AROUND COMMON CENTER OF GRAVITY.
3. SLOWED UP, EARTH PULLS MOON TOWARD IT.
4. MOON COLLIDES WITH EARTH.

Scientists who have been tracing the history of the moon declare that the reign of fire and brimstone which will herald the end of the earth will in all probability be brought about by the moon's falling back upon the earth. The diagrams herewith illustrate the process which astronomers believe will destroy the world after thousands of years. At present the moon is retreating from the earth; the equator bulges slightly as shown by the exaggerated drawing in Figure 1. Lunar tides slow down the earth's motion until eventually the two bodies will revolve around a common center of gravity. When this state of balance occurs, the attraction of the earth will slowly but surely draw the moon toward it, so that after millions of years some distant astronomer of another world will observe a brilliant white glow which will mark the reduction of earth and moon to a white-hot globe of gas.



The 150-hour endurance flight of the "Question Mark" gave convincing proof of the ability of the airplane to survive all sorts of weather and flying conditions. Photo shows the "Question Mark's" mechanic stepping out on the catwalk to adjust one of the motors during the flight.

An Editorial on

THE SAFETY of FLIGHT

Flying is the world's safest mode of transportation!

That is, modern flying is. Figures recently issued by the U. S. Department of Commerce indicate decisively that the chances for mishap while flying modern, up-to-date equipment are less than the risks you run in driving your own car!

In all categories of accidents reported to the Department last year, out of an estimated 10,000 flying planes, there occurred 672 accidents, ranging from nose overs to bad crashes. Out of these there were 127 fatalities. What percentage this represents of the total who flew can not even be guessed at, but it represents but twenty per cent fatalities of those which cracked up. Evidently a man has a five to one shot for his life, even if he does crack up! In this score, aviation is about on a parity with automobile travel.

It is interesting to further segregate the cause of the American air accidents of last year. Poor flying technique accounted for nearly one third the accidents, twelve per cent were blamed to errors in piloting, ten per cent on negligence, two per cent on disobedience to orders, and the remainder were charged to miscellaneous causes.

Given modern equipment, good training, and it would seem from even a cursory consideration of the facts that aviation has at last affianced public confidence. It is, relatively speaking, the world's safest mode of travel.

My IDEA Paid Me

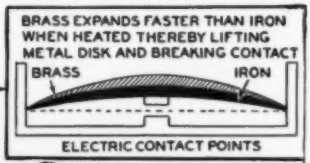
Money and fame await the man who invents some new device which the world needs. These inspiring personal stories of great inventions give a fascinating glimpse into the successes which have come to men who have patiently developed an idea.

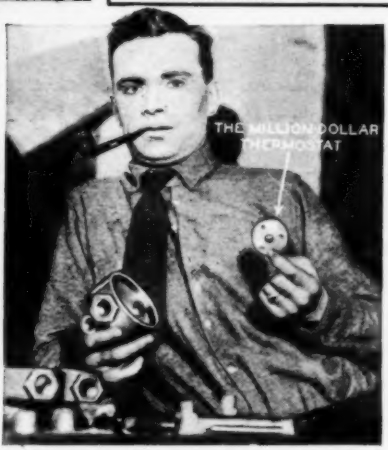
I. An Automatic Iron By J. A. SPENCER

IT WAS through watching the middle section of a furnace door move for a noticeable distance when it warped under the influence of heat at its center that I got the idea of contriving a metallic device which would make use of the principle that metal expands when heated, to turn on and off an electric current.

Seven years spare time went into the study of the problem. When the idea finally proved workable, practically all my limited salary resources were spent. With the assistance of friends a shop was rented and production of my current-controlling thermostat begun. The drawing below gives a good idea of the principle on which the device works. Two metals with different rates of expansion are fastened together, with an electric contact point at the center. When, for example, the brass is heated to a certain temperature, it expands and the disk snaps up like the bottom of an oil can, lifting the contact and breaking the circuit. When cooled, the metal shrinks and snaps the circuit closed again. Thus this little device automatically controls the temperature of an electric iron.

Westinghouse experts, interested in the invention, insisted that it must turn a current off and on 350,000 consecutive times without a single failure before it could be considered a success. The device came through the test with flying colors, having proved its dependability beyond a doubt—the main reason why the housewife today finds the automatic control so satisfactory.


BRASS EXPANDS FASTER THAN IRON WHEN HEATED THEREBY LIFTING METAL DISK AND BREAKING CONTACT
BRASS
IRON
ELECTRIC CONTACT POINTS



The automatic electric iron, shown above coming off the assembling line by the hundred, is operated by a simple thermostat device which turns a current on or off as shown in the diagram. John Alby Spencer, the former night watchman who invented the thermostat, is shown at the right holding his million dollar invention in his left hand.

a Million as told by TEN FAMOUS INVENTORS

These Ten Inventions Are Making Millions for Their Owners:

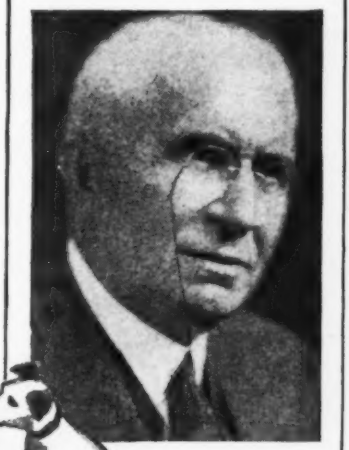
1. Westinghouse automatic iron, invented by J. A. Spencer, former night watchman; 2. Disk record talking machine, of Emile Berliner, dry goods clerk; 3. Motion picture projector, developed by C. Francis Jenkins, stenographer; 4. Hoover vacuum cleaner, invented by Murray Spangler, janitor; 5. The outboard motor of Ole Evinrude, former handy man; 6. Rayon, the artificial silk, developed by scores of research experts; 7. Rice Flakes breakfast food, the idea of Howard Heinz, corporation president; 8. Pyrex glass baking dish, perfected by the Corning Glass Works; 9. Kodacolor colored movies, worked out by John G. Capstaff, former ship-building engineer; 10. Stenotype shorthand machine, the idea of Ward S. Ireland, stenographer.

II. The Talking Machine

By EMILE BERLINER

I WAS born in Germany in 1851 into a family of 11 children. I went to school up to the age of 14 and then worked as a printer's devil without pay, later clerking in a dry goods store. Just before my nineteenth birthday a friend persuaded me to go to America to clerk in a Washington, D. C., dry goods store. For several years I worked in New York, Washington, and Milwaukee, clerking, selling glue, and working in a sugar analyst's laboratory.

In 1883 I became associated with the Bell telephone interests, to whom I had sold my invention of the microphone which I had perfected after considerable experiment. In perfecting the microphone I had naturally acquired a great deal of information on the science of sound, and I became interested in seeing if I could devise a machine which would reproduce the human voice.



Emile Berliner Inventor of the disc record talking machine.

In 1857 Leon Scott, a Frenchman, had invented the phonautograph, an instrument which recorded but did not reproduce the vibrations of the voice. By 1883 both Bell and Edison had worked on the problem. They discovered that sound thrown against a diaphragm makes it vibrate, and were promoting the resulting devices. Edison's phonograph involved a sound recording system whereby sound waves were vertically indented, while Bell's graphophone had vertically engraved waves in a wax cylinder.

After five years of experiment I patented my gramophone in 1888. In contrast with other machines, its record was made horizontally and parallel with the record surface. Soon I was making disk records of the type in general use today, using zinc dies which solved the problem of making unlimited duplicate copies of an original record. It is the disk record which makes present day talking machines able to reproduce sound so faithfully. The Victrola company is the direct outgrowth of the Berliner Gramophone company, which I established in Philadelphia in 1892. The success of the company is well demonstrated by the fact that the name of its product has become a household synonym for "talking machine" throughout the world, with thousands of machines in use.

III. The Moving Picture

by C. FRANCIS JENKINS

C. Francis Jenkins, inventor of a movie projector which he patented and sold to Thomas A. Edison.

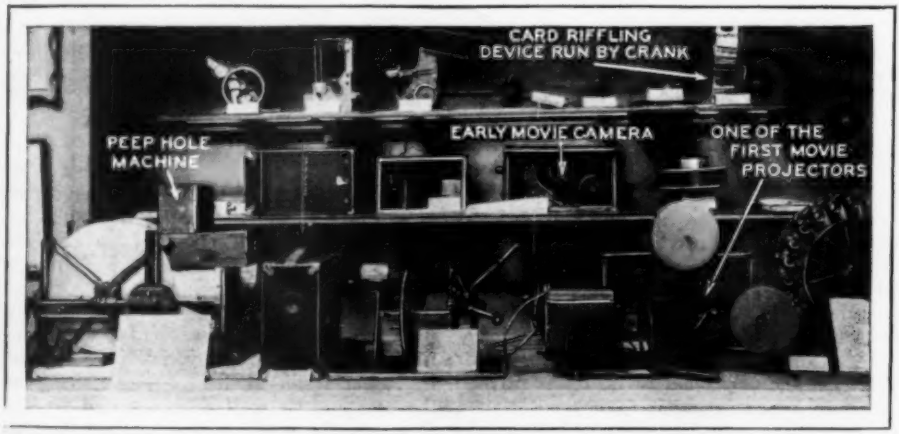
I WAS an adventure-loving young scamp born south of Dayton, Ohio. After a rural education near our farm outside Richmond, Indiana, I restlessly explored the northwest and southwest before finally settling down in Washington, D. C., at the age of 21 as a stenographer.

Always I had fiddled with machinery, and now, while boarding near the capitol, I enthused over Eastman's crude box-camera. "Why not," I argued, "make pictures which give the impression of moving?" That was in 1890. I knew nothing of photography, but after taking a number of still pictures purporting to show people in chronological motion I drew up some rough sketches, bought a lamp, reflector, and camera box, and set to work.

My first "projector," developed in 1893 after three years' spare time tests, worked poorly. Funds were low, but by 1894 I had made a device called a phantascope which turned out better. It photographed moving objects and later reproduced them, giving the sense of continuous motion. Two essentials were involved: a picture mechanism for giving the film a jerky or intermittent movement at the picture aperture, thereby permitting a relatively long illumination, and a loop above this aperture to prevent the film from leaving the projector.

With limited funds, I had great trouble promoting the idea. The rest of the story contains little drama. In 1896, after my phantascope had been patented, Edison persuaded me to sell my rights for $2,500.

The phantascope was the forerunner of the modern motion picture projector, and I afterward regretted having sold it at such a low price. Since then, however, I have taken out over 300 patents, and today maintain my own private laboratory where ideas are turned into reality.



This exhibition of early machines designed to give the illusion of motion to pictures is an interesting cross-section of the early history of the movies. The first of these devices consisted of a series of still pictures mounted on cards which, when riffled in front of the eye in rapid motion, gave the illusion of consecutive motion. From such humble beginnings came the present-day movie.

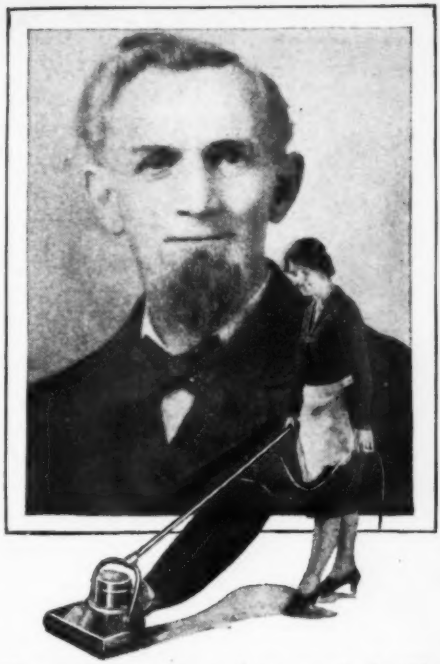
IV. The Vacuum Cleaner

MURRAY SPANGLER

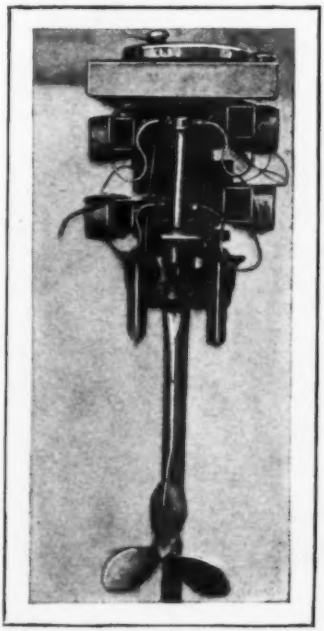
TWENTY years ago Murray Spangler, an Ohio farmer, took a job as janitor in a Canton department store. A "bug" on efficiency, he used all the cleaning implements then available, and even invented a wagon like an old-time fire cart which contained a long hose connected with a tank inside which a vacuum was created by a gas engine. Drawing the wagon up in the street, Spangler would insert a hose through a window and suction the dirt into the tank outside.

From this crude beginning came the Hoover suction cleaner, hailed as the first efficient machine of the portable type familiar today. Backed by W. H. Hoover, a harness-maker who donated a portion of his workshop, Spangler perfected the cleaner after months of patient labor. More years of refinement followed before the cleaner became the small, compact machine in use today.

Murray Spangler, now dead, lived to see his suction cleaner in use in 3,000,000 homes throughout the world.



Murray Spangler, shown above, was the humble janitor who invented the Hoover vacuum cleaner which is in use in millions of American homes. The maid is operating one of the late models.



Evinrude's "quad," fore-runner of the modern outboard motor.

V. The Outboard Motor

By OLE EVINRUDE

A LONG rowboat ride for a dish of ice cream was the immediate inspiration to the invention of the Evinrude motor which is the basis for the familiar outboard engine of today. I had rowed a young lady friend two miles from the lake shore to an island hamlet where a picnic was being held, and upon our arrival she expressed a desire for a dish of ice cream—which meant that I had to row to shore and back again, a distance of four miles. I decided then that there was a need for a motor which could be attached to a rowboat.

About a year later I showed that same girl (who was now Mrs. Evinrude) the model of the first outboard motor. The first one didn't work very well, but in a few months I succeeded in perfecting it. My wife was my partner in our growing business—she engineered a mail-order campaign which sold the motors, while I designed and built the machinery for manufacturing them. In 1911 a national advertising campaign was begun and an organization built up on a production basis. Today there is hardly a lake in the United States without an outboard motor in use.

VI. Rayon, the Artificial Silk

Leonard Yerkes
President, Dupont
Rayon Company

NO ONE man deserves the entire credit for the invention of rayon, the first entirely new and distinctive textile in some 4,000 years of history. But if you were to ask any government textile expert who really put the new fabric on the map in this country, he would probably answer, ex-officio: "the Duponts."

Back in 1884 two young Frenchmen, Reaumur and Chardonnet, after pains-taking study of the silkworm, succeeded in duplicating the process whereby it derived cellulose from nature. They found that when a mass of vegetable fiber, such as mulberry or oak leaves, has been boiled in water containing certain solvents, a mass of colorless, odorless, and tasteless material remains, composed of the membrane which forms the cells of vegetable matter. In 1902 Topham, an English inventor, perfected an apparatus for forming textile fibre from this cellulose solution, and his method is now universally used.

Leonard Yerkes, president of the Dupont Rayon Company, describes rayon as an utterly new textile; it is as if a new color were added to the spectrum. Many fabrics are made entirely of rayon; in others wool, cotton, silk, or linen is combined with it.

The possibilities of profit for the man who can invent another new textile of this nature are evidenced by the fact that over 100,000,000 pounds of rayon were consumed in the United States last year. Already rayon has outdistanced silk in the textile markets.

An interesting fact is that the demand for rayon has been built up within less than a decade. The first Dupont rayon plant was erected at Buffalo, New York, in 1921, and in the first year it produced only 658,000 pounds of product.

Two steps in the process of manufacturing rayon are pictured above. The girl in the foreground is inspecting the finished product, which is delivered in skeins ready for weaving into fabric. The insert photo shows an expert inspecting the tiny metal spinnerets through which the viscous cellulose material which forms rayon is extruded. Rayon is rather inaccurately known as artificial silk.

VII. Rice Flakes Breakfast Food

By HOWARD HEINZ

A DECADE ago I conceived the idea of developing a cereal food which would contain elements capable of overcoming the deficiency of cellulose in the average diet, a deficiency known to produce certain stomach disorders. Whole grain cereals contain an adequate amount of cellulose, but the harsh taste of such grains makes them unpopular. It took 10 years of research before our laboratory workers discovered that cellulose (which is merely "roughage" which aids digestion, but contains no food elements) can be obtained from rice bran in a purified, tasteless and odorless state, and then returned to the grain, which is cooked and flaked.

A manufacturing plant was erected at Lake Charles, La., where rice is raised in large quantities. The tasty product was introduced to the public and met with an immediately favorable reception. Today rice flakes are a favorite cereal food throughout the country.

Howard Heinz
President of the
H. J. Heinz Co.,
who developed a
new cereal food.

VIII. Pyrex, the Glass Baking Dish

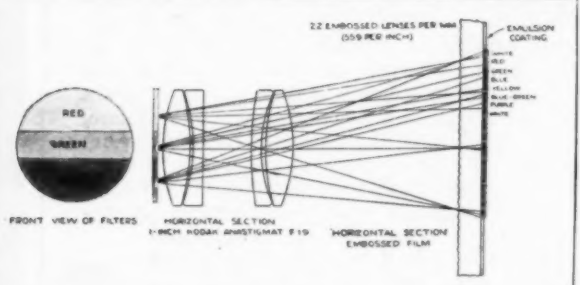
A MINOR household accident which occurred 14 years ago was indirectly responsible for the development of Pyrex, the trade name of a glass which will not break when subjected to heat. The wife of Dr. Sullivan of the Corning Glass Works in New York had lost a pudding dish while moving, and when she visited her husband in his laboratory to tell him of the accident she received such slight sympathy from him that she grasped a glass jar used for laboratory experiments and threatened to bake a pudding in it—which she did. The results were so tasty that Dr. Sullivan set himself to the perfection of an inexpensive glass which could be used for cooking purposes without shattering in the oven.

Pyrex glass does not shatter when heated.

When finally perfected, Pyrex glass was not entirely the invention of one man. Hundreds of experts contributed their knowledge. Pyrex history really dates back to the pioneer work of Otto Schott of Jena, who studied the ability of glass to withstand sudden temperature changes. In May, 1915, the first large order of Pyrex baking ware was produced at the Corning works. It survived all tests. The formula for its manufacture provided for sufficient metallic content in the glass to make it, in effect, elastic; it could not shatter by expanding or contracting suddenly as temperature changed. Today it is used not only for baking dishes but for countless similar uses as well.

IX. Kodacolor, Movies in Color

By JOHN G. CAPSTAFF



John G. Capstaff, at left, is the young Englishman who perfected the Kodacolor system of color movies under the supervision of Dr. C. E. K. Mees of the Eastman laboratories. The diagram above shows how tiny lenses embossed in the film separate the light rays into red, green and blue through the use of a three color filter.

FUNDAMENTALLY, the process by which movies in color are produced is simple enough. An immense number of tiny cylindrical lenses are embossed into the film by passing it between steel rollers. These lenses are only visible under a microscope, being seven times smaller than the dots making up the illustrations in newspapers. A color filter is placed on the lens of the camera and the function of the embossed lenses is to separate the rays of light falling on them so that the red, green and blue rays are imaged behind each tiny lens in three vertical strips parallel to the stripes of color on the filter. There were countless details to be worked out before the system was finally perfected; it would require a text book to explain in detail. The embossed lenses, however, are the real secret of the process.

Kodacolor's history really covers something like 25 years of research. At first the colors were extremely poor, but by last summer the Kodacolor process was perfected and ready for the public. Today it is being used by thousands of amateur cameramen.

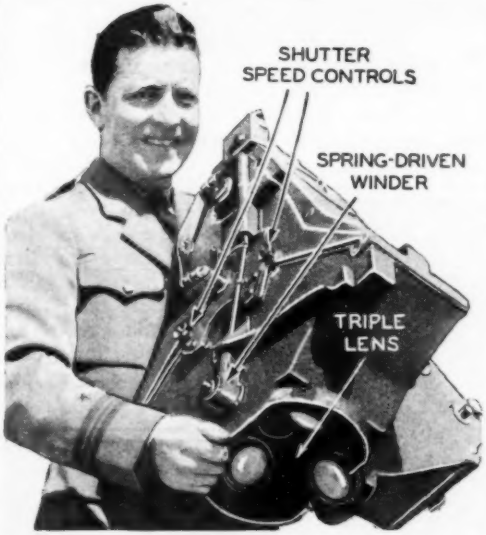
X. The Stenotype

By WARD S. IRELAND

MY WORK as a stenographer impressed on me the fact that taking notes by shorthand is an arduous job. Furthermore, notes taken by one stenographer can not always be transcribed by another in emergencies, even though both use the same system of shorthand writing. Why not devise a machine which would print shorthand symbols in much the same fashion as a typewriter prints letters of the alphabet? This idea for the Stenotype machine came to me in 1911.

Success followed almost immediately after the Stenotype was patented. The photo gives a good idea of how the machine works, printing shorthand characters on an endless tape. The device looks very much like an adding machine. The Stenotype is now produced by the LaSalle Extension University.

Mapping Alaska with a Camera



Twelve thousand square miles of coastline and islands are being mapped by this method on an expedition sent out by the Departments of Agriculture and Interior for the Federal Power commission. The party left May 15, in charge of Lieutenant-Commander Radford. A mapping camera utilizing 480 feet of film in two rolls, on which exposures are made simultaneously on three lenses, will be used. Nineteen thousand feet of film is being carried and approximately 51,000 exposures will be made while flying at an altitude of 10,000 feet.

The plane will attempt some of the longest mapping flights ever undertaken. These will range from 10 to 50 miles in length. Commander Radford is shown above demonstrating the camera.

NOT ALL developments of the World war were disastrous to human welfare. Before that now historic engagement of world powers, maps were sketchily visualized and laboriously drawn. With the adoption of airplanes to war use, some officer conceived the idea that photos taken from a plane flying over enemy territory might be pieced together to make a map that really showed what the country looked like. The idea was perfected and worked to good advantage. The ensuing years since the Armistice was signed have seen the further development.

This Street Car Rides Up or Down Steep Hills on Level

THE founders of Lisbon, Portugal, were probably so enthused over the idea of building the city like Rome on seven hills that they failed to peer into the future and the question of transportation.

Donkeys served the purpose for a considerable period, but with the adoption of modern living conditions this means of travel soon proved slow and tiresome.

Street cars built to accommodate the cars themselves and the passengers to the mountainous grades of the various city thoroughfares were introduced.

They were so designed that despite the steepest grade which the cars climb or descend, the riding platform and seats remain in a horizontal position while the wheels dip with the angle of the street.

This is accomplished by means of a system of balances that is unaffected by the number of passengers in the car.

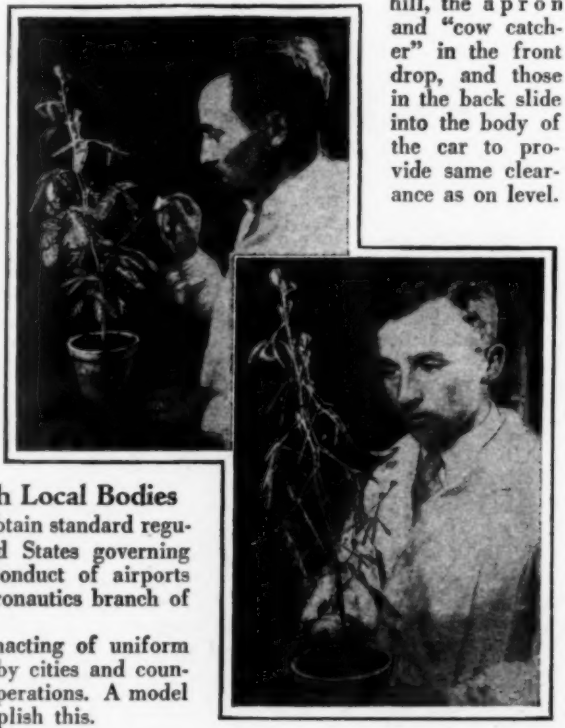
When the trolley is riding on the level it appears much the same as an ordinary car. Coming down a hill, the apron and "cow catcher" in the front drop, and those in the back slide into the body of the car to provide same clearance as on level.

Gets New Leaves in 15 Minutes

FIFTEEN or twenty minutes of "sleep" brings new leaves to this plant that has recently been developed in Germany. So sensitive is it that if the leaves are touched, or a match burned near, they immediately wither and fall off.

A member of the mimosa plant family, it grows in great quantities in India. It is gathered and sold there for commercial purposes. Bruised leaves are used to apply to burns, and the roots are charred for gun powder charcoal.

Photo at right shows a plant with a lighted match being held up to it. The effect the flame has on the leaves can be seen in the lower picture. In 15 or 20 minutes after the withered leaves have dropped off, new ones grow out.



Uniform Control Through Local Bodies

PLANS for renewed efforts to obtain standard regulations throughout the United States governing operation of air craft and the conduct of airports have been made public by the aeronautics branch of the Department of Commerce.

These plans contemplate the enacting of uniform ordinances and other regulations by cities and counties governing flying and airport operations. A model code has been proposed to accomplish this.

This Milk Bottle Holder "Padlocks" Kittens' Cafeteria

LOCKED tightly in this specially developed holder shown at right, a bottle of milk is safe from stray cats and dogs snooping about back doors and porches in search of a meal by tipping the bottle and lapping up its contents.

The holder is attached to the door high enough to be out of reach of wandering dogs or cats. Instead of leaving the bottle standing in the corner of the doorway where it is accessible to anyone who happens along, the milkman merely clamps it in the holder.

There it remains, locked firmly, until released by a lever from the inside. When breakfast is being prepared, the door is opened and the bottle grasped before the lever is pushed.

Cruelty to animals? Perhaps, but self preservation and starting the day right come first.

Few things serve to start the day off worse than a bad breakfast. If someone does away with the milk supply before it is discovered in time enough to get more at the corner grocery, creamless coffee and stale or sour milk are the best known breeders of discontent and grouchiness.

Cat foiled in attempt to get an easy breakfast.

Airplanes Are Being Designed for Passengers' Comfort and Safety

LUXURY in air travel was the keynote of the second all-American aircraft show which was recently held at Detroit, Mich., with a display of 105 planes and 134 accessory booths.

This year marks a tendency to design planes with the predominant idea of comfort and roominess. The day of the barren, cramped, unseated ship is past. Deep upholstery, wide windows, heated cabins, electricity, muffled motors, and dining equipment are among the features of new planes.

Ice Skating Year Around Without Discomforts of Wintry Blasts

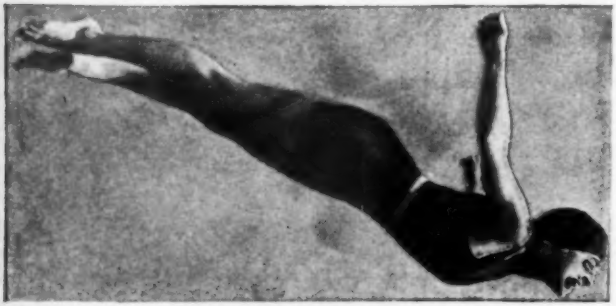
Arthur R. Maas, chemical engineer, pouring hot artificial ice on this heavy screen for skating.

ICE SKATING with the temperature at 90 degrees in the shade! Is such a thing possible? Not only possible, but very enjoyable, according to persons who have experienced it.

Moulten ice, which is really not ice at all but a chemical liquid that hardens and has the same characteristics, is spread over a heavy wire screen and smoothed to a flat surface. When it is allowed to harden, skate runners glide over it as easily as they do over ice.

It is not affected by the warm sun and banana palms and tropic foliage surrounding such a rink are therefore not so out of place as it would seem at first thought.

Mechanics of Plain



Tricks that have made diving champions and experts famous are revealed in this article by Mr. Miller, who explains the principles underlying both plain and fancy dives in easily understood language.

The graceful swan dive is a favorite with Norma Shearer, movie actress, shown above.

Position 1 of the hand-stand dive.

Entering the water in the hand-stand dive.

WHAT a difference in the way an experienced diver glides smoothly through the air and slips noiselessly into the water and the manner in which a "dub" grits his teeth, tenses his body so that it is rigid and splashes with a resounding whack on the surface!

Yet, if the "dub" didn't try, he would never learn. If all desired things came easy without any work, there wouldn't be any fun in getting them. Most fancy dives are accomplished by a lot of nerve and tenacity to stick to it when once you've failed.

Simple Dives Come First

But before fancy dives come the plain, simple ones. While one naturally expects some difference of opinion as to the exact mechanical procedure of a dive, there nevertheless are certain standard methods which are rather universally accepted by the most exacting of the nation's experts.

First of all, as is aptly pointed out by L. de B. Handley, nationally known instructor at the Women's Swimming association, New York City, it is important that the beginning diver be extremely cautious and patient regarding his early efforts. If he is overly ambitious and starts straightaway to essay the more difficult dives, he is liable not only to acquire careless habits, but is exposed to considerable and needless danger. Obviously then, he ought to do his preliminary work from a low board and aim to acquire proficiency in the simplest dives so that later on from the high board he may try the more complex maneuvers with the aid of his newly acquired principles of bodily control.

Study Form by Watching Divers

Our eyes are the ablest ally in most learning processes. The novice will find it advantageous to study carefully the position taken by a good diver when he leaves a board to go into the water.

and Fancy Diving

by JAMES NEVIN MILLER

Earliest practice sessions should be with the front dive. The proper procedure is easily learned. An erect position is assumed on tiptoe, the head upright, chest out, hands at thighs, feet close together. Then the arms are swung out and back a trifle, they are thrown quickly forward and up while simultaneously a vigorous spring is taken. Good height is needed and a straight-out position is advisable. Just before entry into the water is made, the head should be lowered a bit, and the body stiffened so that the surface will be hit in a clean line motion.

The running front dive differs from the standing variety chiefly in the fact that greater height is needed. If springboard is used, then both legs should hit the board forcefully at the same time. But from a stationary platform, height and distance are gained by a vigorous leap from one foot. The front jack-knife needs exceptional height, since the body should fold in two while in mid-air and the entry is made in slightly vertical fashion. The diver should be able to touch his toes with his fingers while in the air.

The headstand dive is accomplished by assuming the position on the springboard above. The usual method is to spring backward and enter the water feet first, having described a semi-circle. A head-first method of entry is sometimes preferred.

The Swan Dive

The swan, which is much more difficult, likewise needs great distance and height. The arms should be outstretched until a fraction of a second before striking the water, whereupon they are quickly brought together above the head.

The back dive should also be practised during initial training, for it serves as the basis for a good many turns and twists. The accepted method is to stand on tip-toe, back towards the water, with the hands on the hips. To obtain grace, a substantial spring upward should be made with the chin pointed up and the back arched. Not until the highest point in the dive is attained should the arms be taken from the hips. They should extend above the head just before reaching the water.

The back-jack-knife, as it is termed, is described by Amateur Athletic Union officials as a "backward spring and forward dive." Their description explains how this maneuver is accomplished: "During the dive the arms must be stretched outwards. The body is cast out and up, is bent at the hips and then rapidly straightened. In an official competition any bending of the knees during the passage through the air will result in loss of points. Entry into the water is with the back turned towards the platform.

Authorities agree that the "handstand" or "armstand," shown on page 46, should be executed as follows: The legs, stretched above the head, are supported on straightened arms with the back hollowed. At the moment perfect balance is attained, the body is pushed outward by a deft movement of the arms, the legs meantime being carried slightly backward. The arms must be stretched downward, and the water

The swan dive is probably the most graceful of them all. In the photo above Helen Meaney, American expert, gives a perfect demonstration of the swan dive before a crowd assembled at the recent Olympic games at Amsterdam.

should be hit as cleanly as in the plain front dive.

Only a diagram can properly serve to illustrate the way to do the running front somersault. One appears on page 49. Experts explain that during the dive the arms should be kept outwards or along the sides. Double up the body into a ball with a single, combined movement, opening out, as Mr. Handley says, by "raising the head, distending the legs and straightening back again simultaneously. This allows you to enter upright, feet first, and arms at the sides. Beginners should never try to learn this difficult dive without first practising it extensively on a suspended harness used in gymnasiums to teach tumbling.

You might naturally suppose that the back somersault is harder to do, but in reality it is easier. Assume a position facing the board, and after whipping down the arms a bit to gain impetus, thrust them up vigorously. Simultaneously jerk your head backward and leap. The legs are brought around, Mr. Handley explains, by a quick bending motion at the waist.

Frank J. Sullivan, swimming instructor at Princeton, says there are five essentials which all would-be divers should observe if they would really perfect themselves in the art. Briefly summarized, they are:

1. **Study the proper starting positions painstakingly.**
2. **Assume a confident approach.**
3. **Usually give a fairly high jump on the take-off, combined with a shoulder lift, so as to gain a maximum of height.**
4. **Watch your form in the air, striving always for perfect control, grace and coordination.**
5. **Entry in the water should usually be perpendicular and the diving position should be maintained extremely close to the time the water is actually struck.**

Diving competition is the most colorful phase of aquatic sport. The thrill a spectator gets from watching a good diver make an approach to the board, poise hesitantly for a few seconds and then go soaring gracefully through the air to knife into the water isn't half the sensation the diver himself gets in being able to accomplish it.

It takes nerve—nerve and confidence—to take off from a high diving tower into the shimmering water gleaming up from below.

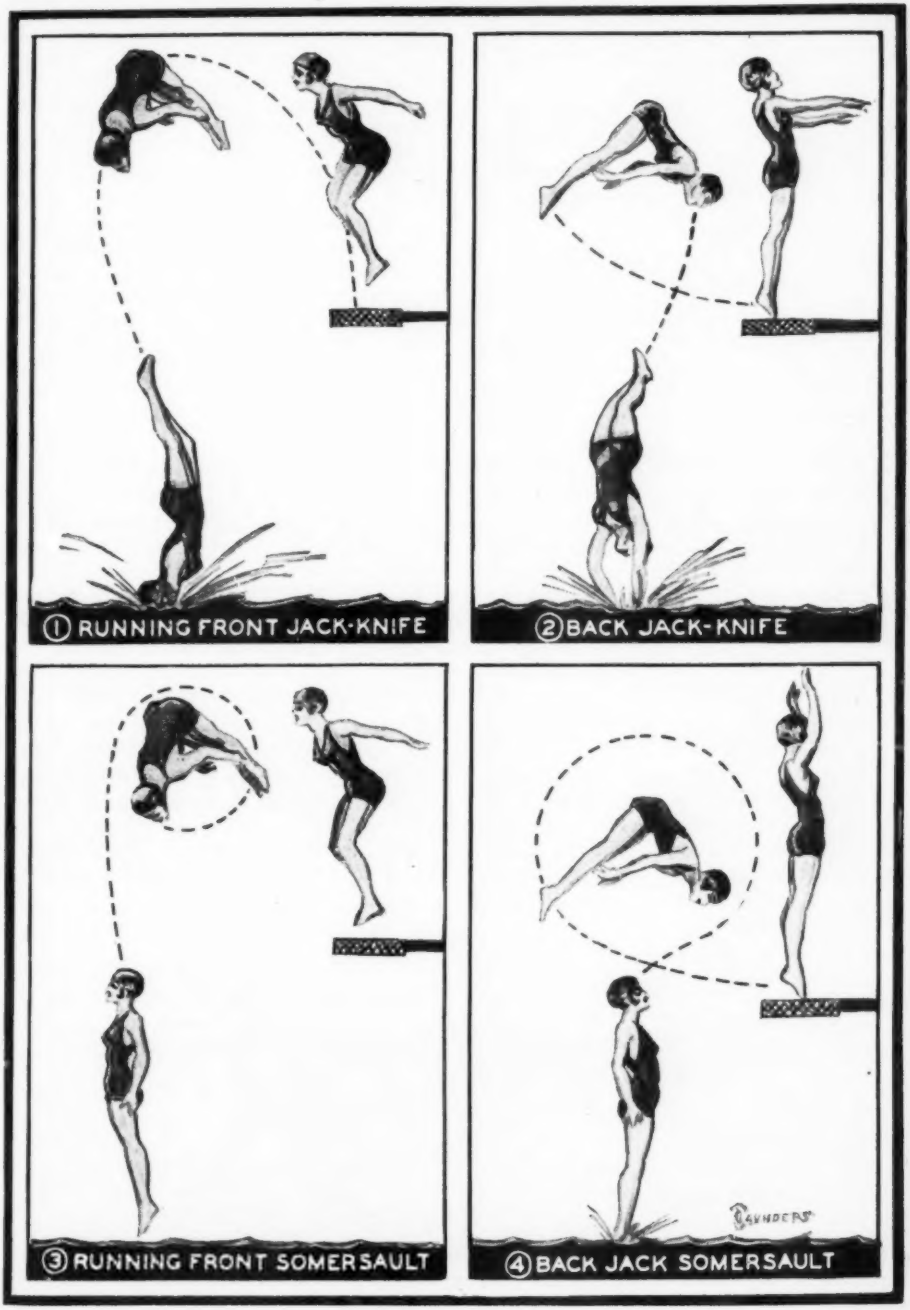
Skill Comes With Practice

An expert diver clambers up the ladder, hesitates on the platform to get his breath and then walks out quietly to the board and takes off with a poise of only a few seconds. He knows what he is going to do in the air and doesn't stop to think about it and become appalled at the height he is going to drop.

On the other hand I have known youths who poised all afternoon on the top of a 30-foot diving tower, afraid to leave the board and eventually climbing down the ladder of the tower. They were not necessarily cowards. They poised too long and thought about it too much.

The formula, then, simmers down to studying what should be done when leaving the board, while in the air and when striking the water. This knowledge mastered, try to execute it from a board of reasonable height, assuming, of course, that you can perform a plain dive well from a low board.

Drawings Show Methods of Executing Popular Dives



Heaters Warm Pilots as They Come Close to Record

SUITS, designed with electric wires sandwiched between the surface cloth and the sheep-skin linings, were used by Captain St. Clair Street and Captain Albert W. Stevens to protect them from the intense cold they encountered in the rarefied atmosphere far above the earth.

Three hundred and sixty-four feet higher and they would have smashed the world's altitude record of 37,854 feet! The two pilots were testing camera equipment in high altitudes. Exhaustion of their gasoline supply seven miles above the ground caused them to make a landing. The heating units shown at left generate their own electric current by means of small air turbines. The apparatus in the central foreground is the camera that was used.

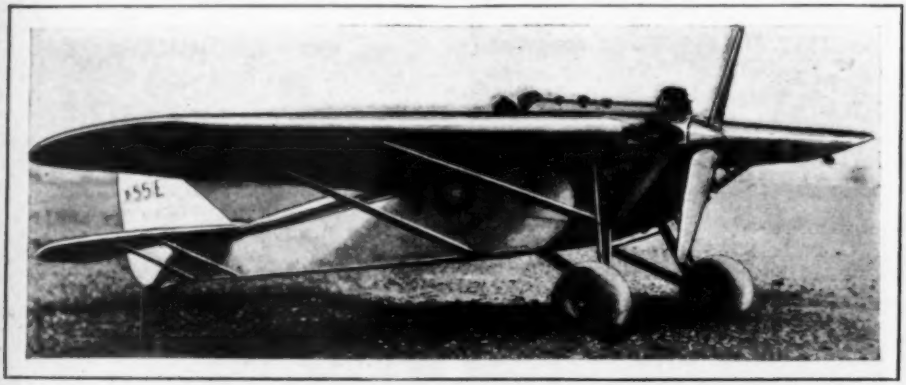
"Lindy" Takes First Ride on Train Since Historic Flight to Paris in '27

WHEN Col. Charles A. Lindbergh boarded the North Shore Limited at the Grand Central Terminal in New York recently, he broke a rule of travel that he has adhered to since his flight from San Diego to New York and thence to Paris in May, 1927. He accompanied the party that bore the body of Ambassador Herrick to Cleveland. Although he has traveled more than 100,000 miles since his non-stop flight to Paris, this is the first time that he has used a train. Short distances were covered by automobile.

Even before his historic journey, before his air mail and army days, Lindbergh did little train riding. He either piloted his wartime "Jenny," used a motorcycle or rode as passenger in the planes of others.

Balloon Tire Shock Absorbers Simplify Structure of This Monoplane

ELIMINATION of the need of shock absorbers has been realized in the design of tires on the airplane shown below. This ship is capable of doing 95 m.p.h. and has been tested in recent trials by Captain E. T. Bruce, formerly of the British Royal Air Forces. An added measure of safety has been developed in the high, double-strutted cantilever wings. The balloon-shaped tires weigh less than shock-absorbers.

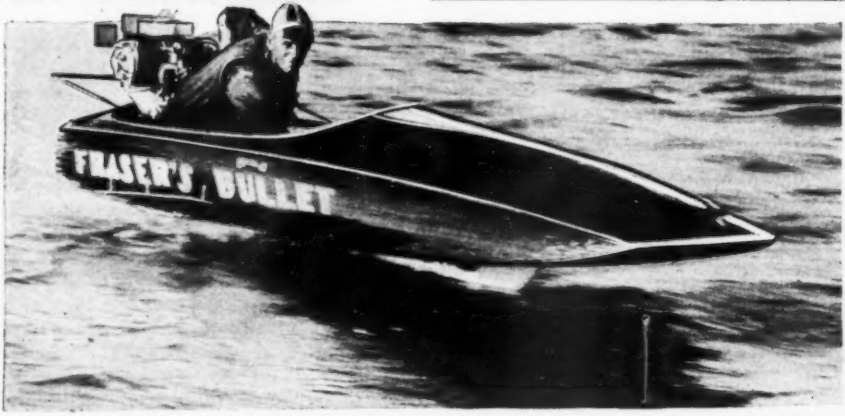


V-shaped landing gear and double-strutted stabilizers strengthen this plane and insure greater safety.

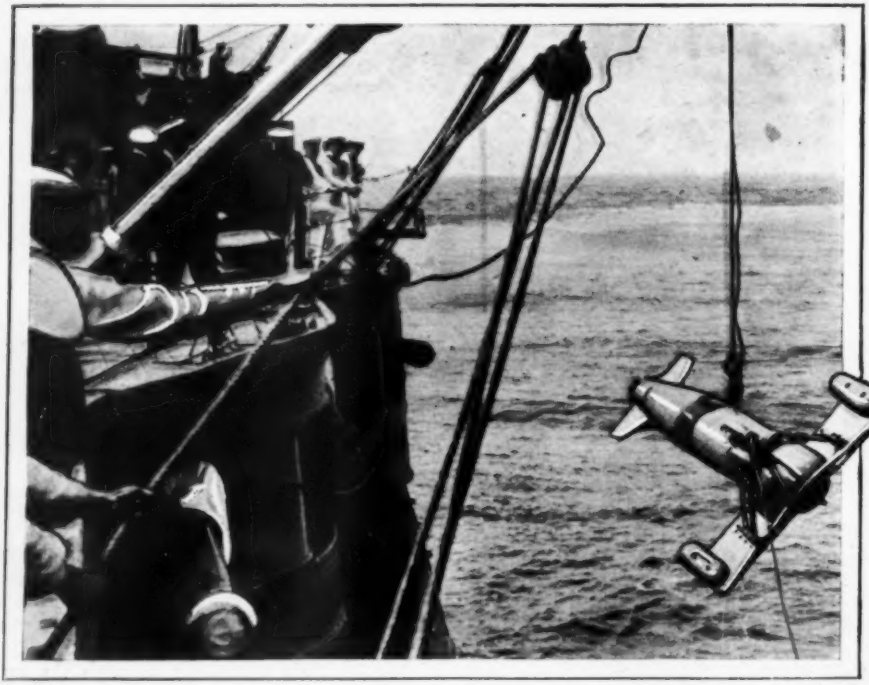
Stunts with Outboard Motors

This "sea cowboy" is sitting on a real saddle that is attached to the seat of the boat.

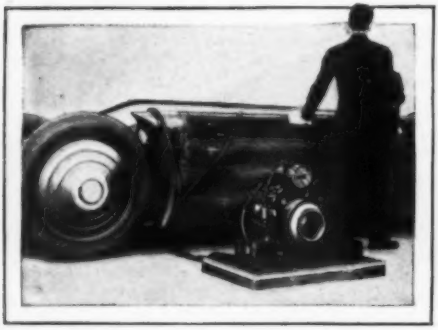
ONE of Malcolm Pope's stunts during the water rodeo at the Florida Orange Festival was to take off in his outboard motored "Sea Horse" from an inclined platform at a rate of 35 m. p. h., to glide gracefully through the air into the water. He is shown above just as he left the slide. The propeller is pulled to a horizontal position in order not to scrape on the incline. Harrison Fraser, shown below, is in the act of breaking the world's speed mark for Class D outboard motors with a rate of 43.76 m. p. h.



Launching a Paravane to Cut Chains of Floating Mine



DESIGNED to perform work too dangerous for human hands, paravanes were used to advantage during the World war to sever the chains of floating mines. The photo shows British sailors of H. M. S. *Marlborough* launching a paravane at sea, and gives a good idea of the airplane-like appearance of this novel machine. The fins on the tail are set at such an angle that when a paravane is towed alongside a ship it dives down a considerable distance below the surface. The front edge or "wing" of the paravane is fitted with sharp blades which cut easily through the chains which hold mines beneath the surface. Sometimes, of course, the paravane strikes the mine itself rather than its chains, and an explosion ensues—that's why paravanes are used instead of man power in releasing mines! When severed, the mine bobs to the surface where it is rendered harmless by exploding it with rifle fire.



Air Motor Starts "Golden Arrow"

WHEN Maj. H. O. D. Segrave, who recently shattered the world's speed record with a mark of 231 miles an hour, tuned up the powerful 900 h. p. Napier engine for his race against time at Daytona Beach, Fla., it was necessary to start the "Golden Arrow" with a compressed air motor.

The photo to the left shows the racer being started by the air motor. This was necessary because of the fact that Segrave's car was geared so high. It is capable of going 92 m.p.h. in low, 166 in second, 240 in high.

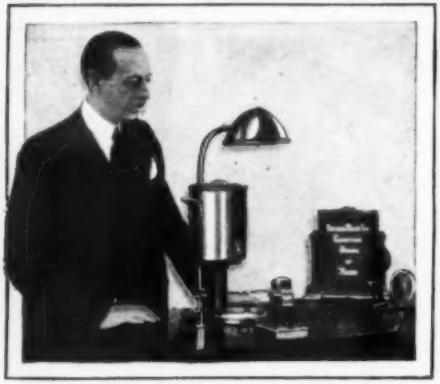
FISHING for TUNA WITH a KITE

FORWARD SPEED OF LAUNCH KEEPS KITE ALOFT
FLYING FISH BAIT SUSPENDED FROM KITE WITH LINE WHICH BREAKS WHEN TUNA STRIKES
KITE GIVES BAIT BOBBING MOTION TO ATTRACT STRIKING TUNA

The upper photo shows the sportsman seated in a swivel chair in the stern of a launch ready to lower his kite with its flying fish bait to attract the gamey tuna. The lower photo shows the bait being hooked to the kite.

FISHERMEN have developed a novel method of fishing with kites in angling for giant tuna 20 to 50 miles off the coast of southern California. The tuna, which ranges from 20 to 350 pounds in weight, strikes only at live and active bait, its favorite food being the flying fish which frequent California waters. To attract the game fish, the flying fish bait is suspended from a kite about 30 feet above the water by means of a slender thread which breaks when the tuna strikes. A hook is threaded through the bait, running to the reel of the fisherman who sits in the stern of a launch. The speed of the launch is adjusted to just the right degree to keep the kite the desired distance above the water, so that the bait skips and jumps over the waves in the lifelike manner of the flying fish. When the tuna is hooked, a battle royal ensues which often lasts for several hours before the fish is brought to gaff. The kite method is the only one yet discovered which gives a sufficiently lifelike appearance to the bait to attract the tuna.

Chemists Welcome Machine to Count Drops of Liquid



TALLYING drops of water electrically is possible with the device shown in the photo at the left. The machine is expected to be adopted for use in chemical laboratories, where liquids must be measured exact in order to follow the correct formulas.

The device makes use of the well known fact that water will transmit an electric current. A circuit is set up which is broken for a space of a sixteenth of an inch or less, and through this opening the water, measured into drops, passes. Each time one drop passes through, the circuit is closed, the current flowing through the liquid to record its passage on a counting instrument like a cyclometer.

The apparatus is the invention of Veeder-Root, Inc., Hartford, Conn. It was recently exhibited in New York City.

Hoover Installs Own Radio Set

EVIDENTLY the perambulating, home-made radio set mounted on a two-wheeled tea wagon, which ex-President Coolidge used, has gone the "way of all good flesh." At any rate no trace of it was found when the new occupants of the White House, President and Mrs. Hoover, moved in. One of his first orders was to have his radio set installed in the State dining room.

Grandfather Cat Discovered

THIS cat, shown below, or rather what remains of him, is approximately ten million years old, scientists have estimated.

"Dinictis Squaliden," meaning the cat with teeth like a shark, is a member of the oldest known cat family. This specimen was found at Hat Creek Basin, Sioux County, Neb., by Paul C. Miller, associate curator of paleontology at Walker museum, University of Chicago. Prof. Miller is shown pointing to the long teeth.

Skeleton of this ancient cat is 10,000,000 years old.

Device Squares up Emery Wheels

ANYONE who owns an emery wheel which has been worn uneven with use may easily square up its surface with this simple, homemade device.

It consists merely of a bolt with four or five washers encircling it.

Grinding of the washers in this simple device serves to square up the surface of the emery wheel in a few trials.

Experts Solve Tide Questions

HAVE tides in the Atlantic ocean anything to do with mountain streams in the Alleghenies? This question was engaging the interest of residents of DuBois and Clearfield, Pa. They became so interested that observations were taken daily of variations in the waters of the Susquehanna river.

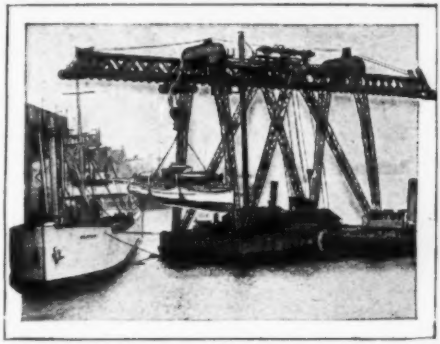
A resident of Clearfield said that he watched the rise of the water below the Clearfield dam. He found it to be an inch or so higher around noon-time. Was this, he asked, the result of tidal action? The question was taken to experts of the United States Coast Geodetic Survey office. Their answer was: "Water doesn't run up hill."

Huge Navy Crane Lifts Ship Off Steamer Deck With Ease

WITH the aid of a giant navy crane, the cabin cruiser, *Seline*, was hoisted from the decks of the Swedish steamer which brought it to the United States and slipped into the water along side the docks of Pier 42, Charlestown, Mass. Two navy tugs assisted in the feat.

The ship was ordered by a Worcester sportsman and is beautifully designed. The cabin of the cruiser is fitted in palatial style.

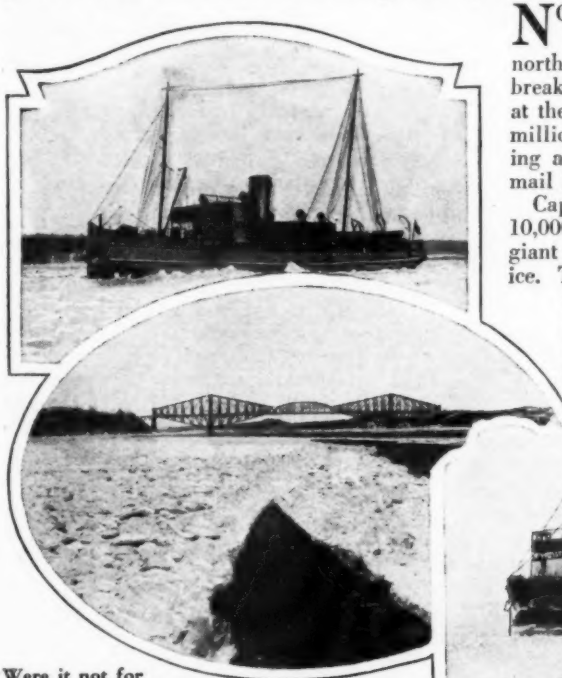
The huge crane, electrically operated, is one of the most powerful in the world and is especially designed for unloading heavy objects from ships when shore cranes may not be accessible. The long elevated track is fitted with rails which permit loads to be moved about on wheeled slings, as shown in the photo.



Jack Frost's Realm Is Disrupted by These Powerful Ice - Breakers

NOISE of crashing and groaning ice fills the crisp air of the arctic and northern regions of America when ice-breakers of the type shown in the photos at the left battle their way through the millions of tons of frozen debris, making a path for expedition steamers or mail boats that are to follow.

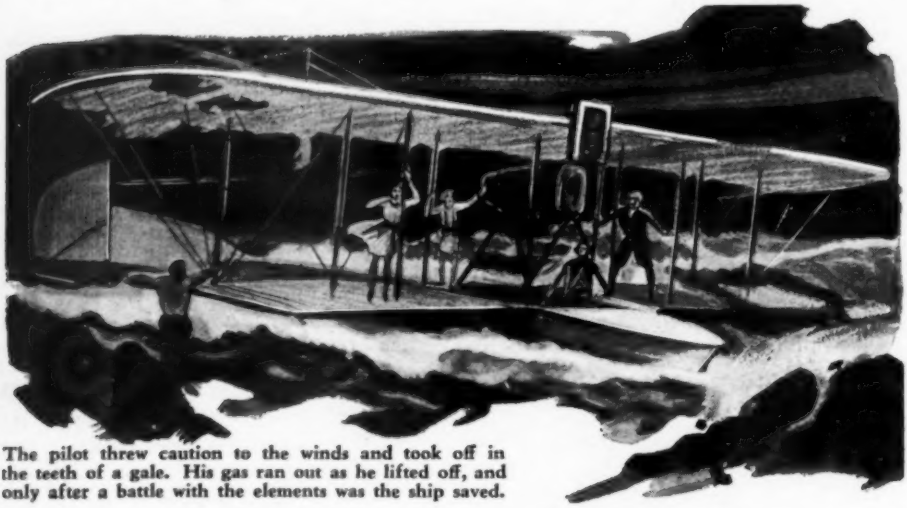
Capable of generating anywhere from 10,000 to 25,000 horsepower, these giant breakers can move whole fields of ice. They consist of crafts built along the lines of a modern battleship, insuring a strong up-thrust against the ice mantles. Ice breakers are used extensively on the Great Lakes.



Were it not for ships such as these shown above, seven of the ten leading ports of the world, located in Jack Frost's realm, would be closed to commerce and business during four or five months of the year.

Ice-breakers vary in size and power according to the thickness of the ice they are supposed to break and the extent of the ice field which they must furrow through. Where the ice is not very thick, small steel launches serve the purpose very well, but in the arctic regions immense ships are necessary. The circular photo in the center shows a path that has been plowed by a steamer on the St. Lawrence river. Propellers are protected from the ice by specially constructed sterns which guard the churning wheels.

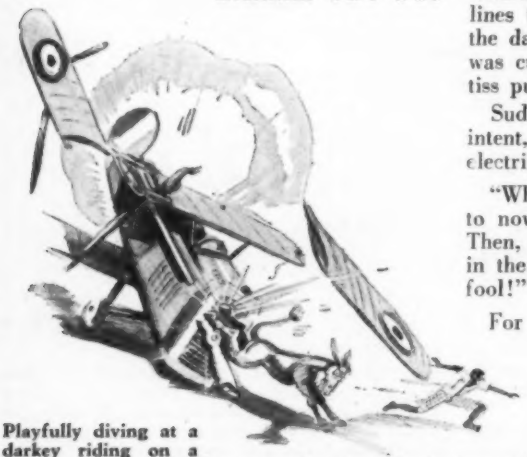
FLYERS have the World's



The pilot threw caution to the winds and took off in the teeth of a gale. His gas ran out as he lifted off, and only after a battle with the elements was the ship saved.

To join the famous Flying Jackass Club, one has to earn the title of "Flying Fool," by being proved guilty of some outstandingly silly piece of piloting. Related here are some of the thrills which have made men eligible for initiation.

LOITERING in the benevolent shade of one of the hangars at Wright Field, a group of army flyers watched with casually interested eye the aerial capers of another lieutenant who was putting his machine through screaming chandelles, wing overs, and sickening dives. His masterful piloting was up to the usual army standard. The exhibition would have brought forth newspaper headlines ten years ago. Today it was all in the day's work. With a last roar the gun was cut and the pilots yawned. The Curtiss pursuit leveled off for a landing.



Playfully diving at a darkey riding on a mule, one Kelly field flyer narrowly missed death when with a freak kick the mule wrecked the big D. H.

Suddenly the little group became quietly intent, stiffening with attention as though electrified.

"What the deuce is Lieutenant Blank up to now?" whispered one man to himself. Then, as he deduced the intent of the pilot in the air he muttered softly, "The flying fool!"

For it had become apparent that after getting his daily time in the air, after having put the fast pursuit ship through "every thing in the book," Lieutenant Blank intended to finish the performance off with a spot landing between two ships which were drawn up with just

Strangest Club

By a Member of the Club

One movie flyer received the shock of his life when he was blown out of the cockpit in an upward direction. His chute opened, caught fire, but he landed safely in the sea.

Imagine the predicament of the girl novice who, claiming to be an expert jumper, had to be cut loose from the plane only to land in water—unable to swim a stroke!

enough room to allow another ship to slip through—perhaps.

Whirr! The singing of the rushing air fell off, the motor ticked over softly as the pilot kicked rudder and brought his plane in line with the opening. The tail settled. The ship seemed to be stretching her glide to the line between the two other perfectly groomed flying engines of destruction.

"By George, he'll make it," cheered one, then—

Crash! Crumph!! The two other ships suddenly came to life, and borrowing motion from the wing tips of the other plane, the three were embroiled in a splintering crash.

"It isn't everybody who can crash three ships with one landing," voiced the onlookers. "Get the trophy—we'll initiate him into the Society of Flying Jackasses."

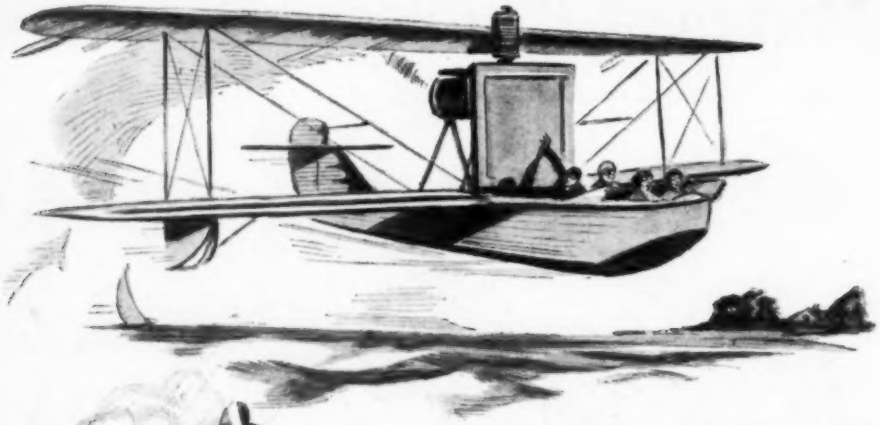
Wherewith the unfortunate Lieutenant Blank was presented with a trophy—a silver loving cup, on which his name is added to the list of flyers at Wright Field who have miraculously lived through dumb-bell maneuvers.

Kelly Field has a similar Club. It is called the Dumb-bell club and is organized to perpetuate the asininity of pilots who can qualify by coming back alive from their fool flying.

One pursuit pilot at Kelly recently was flying alone above the field. Feeling frisky, and wishing to engage in a sham battle, he selected as his opposing "Plane" a darkey plodding along on muleback. Nosing his ship down for a third time, he leveled off. This time he was closer than ever, and the screaming flying wires sounded like a fire siren.

Terrified, the darkey "took to his parachute" as the Dumb-bell Citation reads—but the mule elevated his rear guns and let fly at the prop. This was something the pilot had not counted on. The heels of the mule sent the prop one direction, the land-

Hatch Cover Nearly Wrecks Flying Boat by Blanketing Tail Controls



Pilot Gene Shank, of Modern Mechanics' staff, once jokingly took two frightened girls on what was to be a "thrill hop" in a flying boat. Telling them he expected the trip to be his last, imagine the lump in his throat upon taking off when he was unable to get response from his tail controls, because a hatch cover had lifted out of place and blanketed the control surfaces!

Another instance of freak air happenings occurred to Dick Grace, the famous movie stunt flyer. Having come within an hour's time of finishing some hazardous aerial photography, his motor conked—went dead—and a crash landing was made over the side of the cliff.

ing gear the other. The ship was wrecked. The pilot, unharmed, is now a member of the Dumb-bell club.

An unusual exploit was experienced by William Thomas Ponder, MODERN MECHANICS' distributor at Fort Worth, Texas. During the Democratic national convention held last year at Houston, Texas, Ponder was engaged to fly some pictures in a night flight from Houston to St. Louis.

Ponder was flying through the darkness over the Ozark Mountains when his motor conked—went dead. Volplaning down over the jagged peaks estimating his chances of avoiding a total washout he sighted a small open, level spot, the only possible landing place within his gliding radius. But the plot was so small Ponder knew that he must either strike a haystack in the yard or the solid-looking farm house.

Accustomed to split-second decisions, Ponder decided to literally "hit the hay" for the night. Diving with the wind whistling past the wires of his ship, Ponder so manipulated his controls that one wing of the ship crashed into the haystack and sent his ship pinwheeling around the stack. Instantly on hitting the hay Ponder was asleep—unconscious and counting stars. He was not severely injured, however, and soon was making plans to speed the pictures on to St. Louis.

An exploit of this kind is part of a day's work for Ponder, who flies constantly in connection with his work of distributing MODERN MECHANICS and conducting his airplane agencies. He is a flyer of long experience, a noted wartime aviator.

Civilian flyers have their "unwritten clubs," too. The Caterpillar club, so-called because it is composed of flyers who have had to jump in a parachute to save their lives, has little short of a hundred members today. Charles Lindbergh is a four-time member, having had to jump four times to save his life.

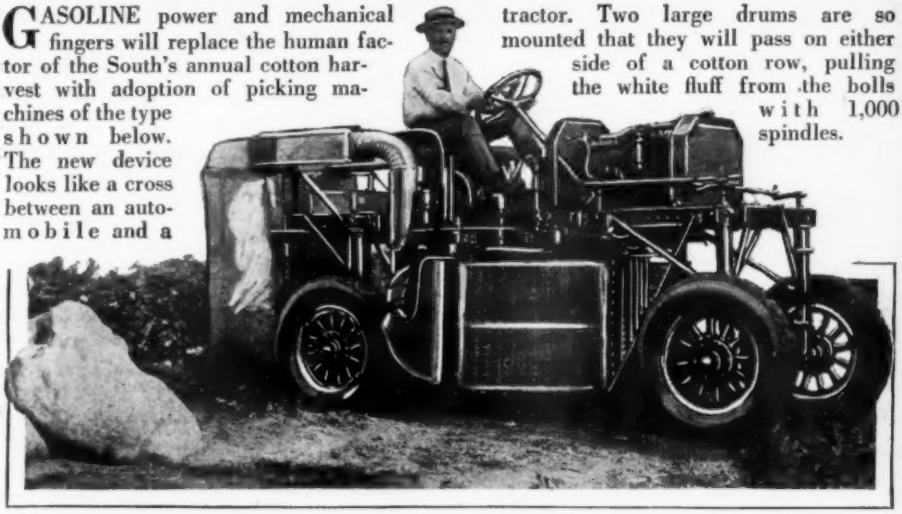
The men who are in commercial aviation have many tales of incidents paralleling the Flying Jackass and Dumb-bell exploits.

For instance, take this for a strange tale —which is true, however. At an airport

(Continued on page 168)

Harvester Does Work of 50 Pickaninnies in Cotton Fields

GASOLINE power and mechanical fingers will replace the human factor of the South's annual cotton harvest with adoption of picking machines of the type shown below. The new device looks like a cross between an automobile and a tractor. Two large drums are so mounted that they will pass on either side of a cotton row, pulling the white fluff from the bolls with 1,000 spindles.



This mechanical cotton picker is equipped with electric headlights and can be operated at night.

Views of Historic Scenes From Air

THE seasoned traveler from Persia, sitting in the Bagdad airdrome waiting to take the eight-hour trip to Gaza, might have reflected that several years ago the same trip would have taken him 40 days of travel by camel.

He might also have wondered whether he was getting as much out of the country now as then. But let this gentleman say what he will about traveling in a camel caravan, there is one unforgetable view which can be obtained only from the air.

It is the view of the serpentine river, Euphrates, at the time the "hind of the morning" struggles to break through. As the sun finally bursts forth in all of its glory, it takes on more and more the appearance of a snake, twisting and writhing, its skin a dazzling metal.

A splendid view of the Dead Sea is also obtainable.

Collects More Than 5,000 Pipes

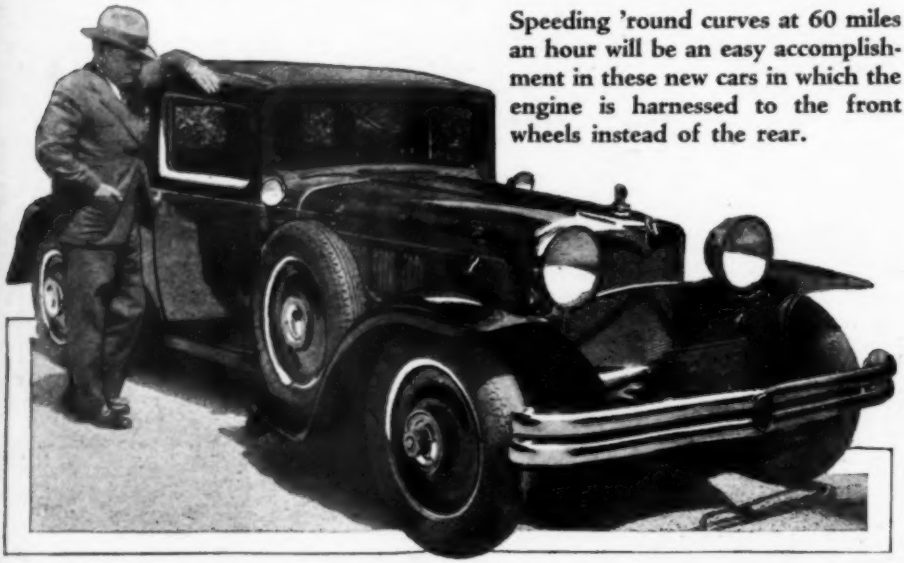
A LIFETIME of pipes! E. J. Church, of London, England, is shown in the photo at right, with his collection of 5,000 pipes, gathered from all nations.

He began his hobby when he was a mere boy. This initial interest was instrumental in his choosing the occupation of a clay pipe-maker as a means of making a living.

His clever ideas and originality of design and composition have made him famous in his line. Along with his work he kept up his odd hobby of collecting queer and ancient pipes. Thousands of persons have viewed his array of smoking "stoves." Now that he is retired, there is nothing he enjoys more than showing his collection to someone.

He is shown fashioning an intricate pipe bowl from a lump of clay.

At Last--a FRONT-WHEEL



Speeding 'round curves at 60 miles an hour will be an easy accomplishment in these new cars in which the engine is harnessed to the front wheels instead of the rear.

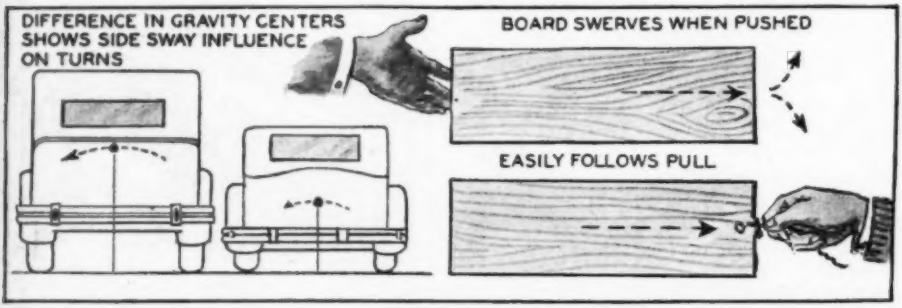
RACE car drivers and automobile engineers throughout the United States and foreign countries have held the opinion for some time that adoption of the front-wheel drive to pleasure cars will result in greater satisfaction of motorists in road performance than they have ever received from a rear-wheel driven car.

Up to the present time, European engineers have experimented more with front-wheel driven passenger cars than Americans have. Now, however, an American manufacturer has produced a front-wheel drive car that is to be announced July 1st.

Who is making the car remains a deep, dark secret. In place of the manufacturer's trademark on the usual name plate on the radiator front, a large question mark reposes mockingly.

Radical changes in construction are evident to even the casual observer. It is built so low that no running board is needed as a step to gain entrance to the interior.

Power is transmitted to the front axle by a short drive shaft and four universal joints. The gearshift operates from the

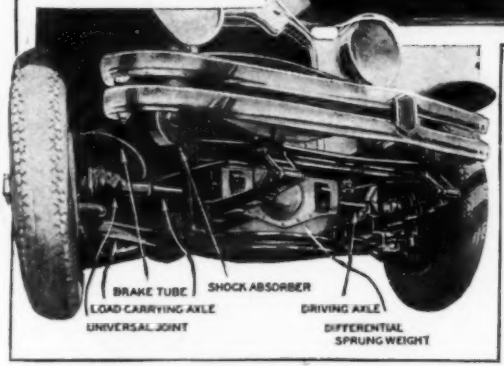


High speeds are maintained on curves with the front-wheel drive car due to the fact that the front wheels are both leading and furnishing the traction. The principle is the same as that shown when a board is pushed with the fingers or pulled with a string.

Drive for PLEASURE CARS

dashboard on a sliding arrangement.

Attaining a speed of 90 miles an hour, the car weighs 2,500 pounds. It has a wheel-base of 130 inches. Athough it appears to be heavily underslung, its appearance is the same as that of a rear wheel driven car.

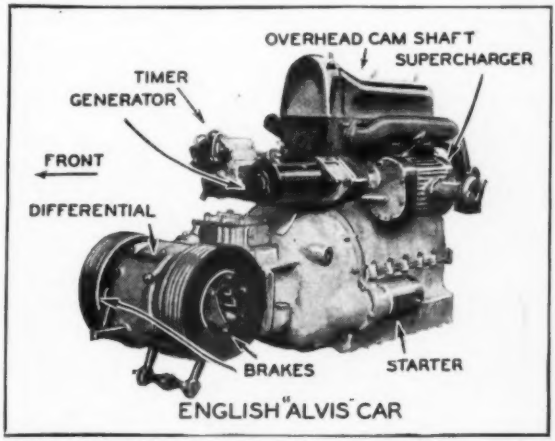


The low-slung appearance of the front-wheel drive car is shown in the photo above in which it stands alongside a conventional type car. On the left the photo shows how the front-drive operates.

Interested automobile owners are asking, "what are the advantages of these radical changes in both design and construction?" They are many. Lowering the height of a car decreases the center of gravity at which it rides. This, in turn, eliminates side sway and makes the car extremely difficult to overturn. Power derived from front axle serves to pull the car rather than push it. This will allow a front-wheel driven car to round a curve on a good highway at 60 miles an hour without fear of going off the road or turning over. Skidding is practically eliminated.

Development of the front-wheel drive is not in any sense new except in its application to passenger vehicles. Early in 1928 the Alvis, front-wheel drive pleasure car was built in England after about a year of experimenting. Many of these experiments were based on performances made by American front-wheel driven racing cars. A year of manufacture and use has been received very favorably by motorists in that country.

Better distribution of weight and chassis is afforded in the car. It is so assembled on the frame as to allow independent springing of each wheel when a bumpy stretch of road is hit.



Motor adapted for front-wheel drive by English car maker.

Collects Guns for Past 40 Years as Interesting Hobby

An interesting display of more than 700 guns of various designs covers the walls of a room in E. A. Hornbeck's home in San Diego county, California. He is shown in the circular inset examining an old blunderbus that was used in England shortly after gun powder was first discovered.

THERE are many varieties of collectors, or rather, there are collectors of many varieties. Some do it as a hobby, some as a business. E. A. Hornbeck, San Diego county, Calif., is one of the former group. He has enjoyed himself for 40 years gathering different kinds of guns.

Gets 90 Miles on Gallon of Gas

THIS youngster, shown in the photo below, is the envy of all the children in her neighborhood. Her "private car" runs from its own power and is easily operated. It was built by her father and is capable of going 30 miles an hour. She gets about 90 miles on a gallon of gas.

This miniature car is run by a 2½ h. p. motor.

Quench Fire With Aid of Planes

EFFICIENCY of the Ontario Forestry Patrol, through the use of planes in fighting fire, is lauded by Evan David, prominent American authority on aeronautics and well known novelist.

"I know of one incident," he said, "where a lookout spotted a fire 30 miles away and within a scant 30 minutes planes were taking off from almost half a dozen bases, carrying fire fighting equipment and men to man it.

"The fire, which under conditions three years ago would have destroyed tracts of valuable timber, was extinguished almost at its inception. People living five miles away did not know it had broken out until planes swooped down and extinguished it."

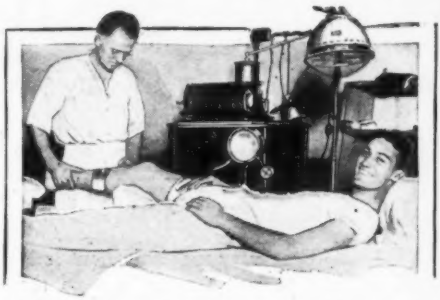
The Ontario provincial air service Mr. David refers to has 22 planes operating all summer for forestry patrol and fire-fighting.

Device Limbers Up Athletes' Stiff Muscles, Sore Cords

SCIENCE enters the domain of athletics much more than the average person thinks. When the muscles of a track man are sore and stiff, he not only gets a good rub-down by competent trainers, but is given a diathermy treatment.

The machine used for this sends an electric current through the sore muscles and stiff cords, heating the bruised parts and taking away the soreness in a short time.

Bob Spence, University of Chicago football player, is shown at the right being treated for a "charley horse."



This machine treats bruises with electricity.

Breaks Record Despite Weather

SOARING high to avoid bad weather, and flying blind for more than half the distance from Los Angeles to New York, Capt. Frank Hawks recently established a new non-stop flight record between the two cities.

Capt. Hawks piloted his Lockheed Vega air express across the continent in 18 hours, 21 minutes and 59 seconds.

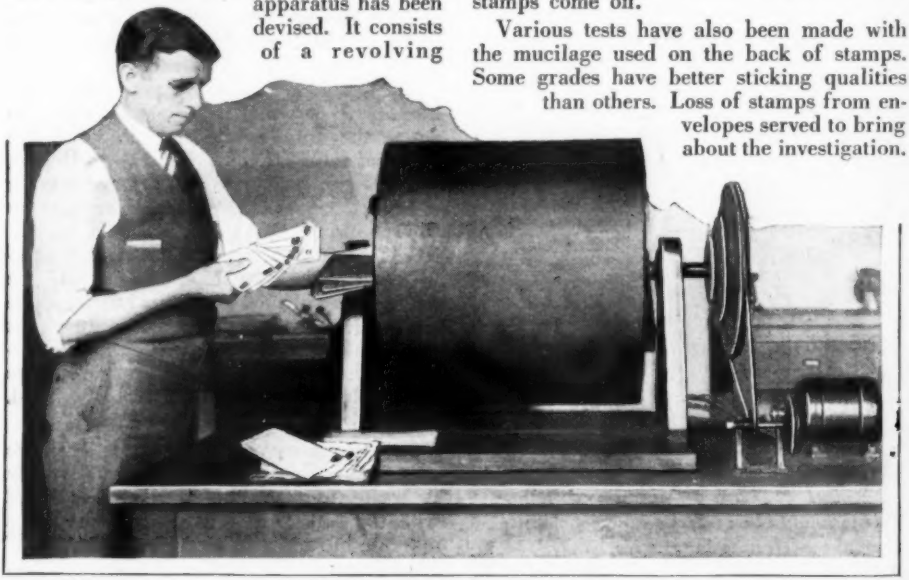
50,000 Fords Touring Sweden

SWEDEN'S automobile world recently celebrated an important jubilee when 50,000 Fords lined up to start a tour of the country, going first to Gothenberg, then Malmo in the south of Sweden and up to Norrland. It will take several months to make the trip.

Government Experts Testing the Sticking Quality of Postage Stamps

UNCLE SAM'S experts at the Bureau of Standards are endeavoring to determine how sticky a postage stamp should be. With this object in view, a special testing apparatus has been devised. It consists of a revolving drum into which letters with stamps attached are placed and rolled over many times. So far, it has been found that envelopes will tear and wear out before the stamps come off.

Various tests have also been made with the mucilage used on the back of stamps. Some grades have better sticking qualities than others. Loss of stamps from envelopes served to bring about the investigation.



Envelopes placed in revolving drum were jostled and whirled about for hours in an exhaustive test.

Table TRICKS with Knives

By SAM BROWN

The after-dinner tricks with knives and forks described here by Mr. Brown can be performed with little advance preparation, and they afford sure-fire entertainment for everybody.

NOTHING so very magical about knives and forks. Once upon a time there was a man who ate peas . . . But that's something else again.

How's this: The performer exhibits a napkin. He rolls it up loosely. He pokes a fork down into the center of the rolled up napkin. And then . . . abracadabra . . . the fork slowly rises from the napkin, bowing quaintly to the bewildered spectators.

It's really too easy. You have a napkin which is slightly prepared. This preparation consists of opening up a small portion of the napkin seam along one side and inserting a two-inch bit of elastic in the hem. Both ends of the elastic are sewn securely to the cloth. Well, that's the idea.

This jack-in-the-box fork pops out of the napkin when the performer loosens his hand. The insert shows how a strip of elastic concealed under the napkin hem supplies the lifting power.

You roll up the napkin. You hook one tine of the fork through the bit of elastic, as shown in the photograph. (The photo shows the napkin unrolled for the purpose of illustration.) You poke the fork down into the napkin. You hold it tightly. When you release the pressure of the hand holding the napkin, the fork rises, quickly or slowly as you desire, and in a manner truly magical. At the end of its journey, the fork is removed from the napkin, allowing the rubber band to slink back to its place of concealment under the hem. Watson, the next case!

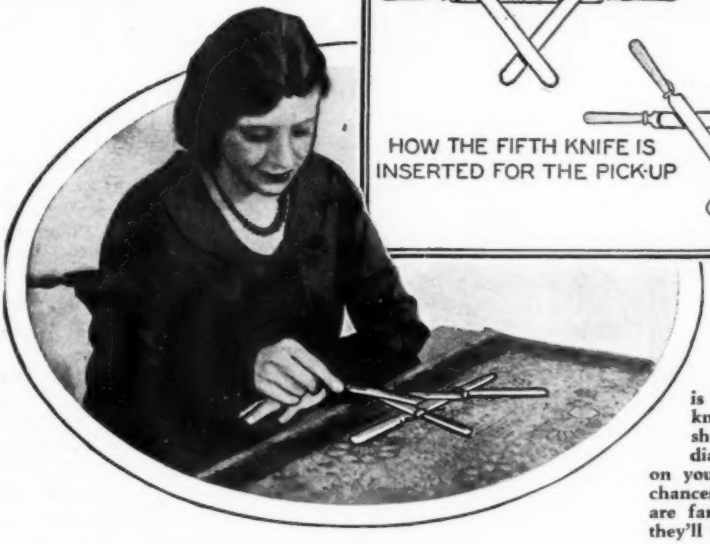
Something simpler: The performer takes a knife and places it in the center of a napkin. He doubles the napkin diagonally so that the knife is enclosed between the folds. He rolls up the napkin, starting at the fold and rolling towards the corners. Now, just being sensible, you would unhesitatingly say that if the napkin were unrolled the knife would still be inside the diagonal fold. Of course! But . . . Oh my, . . . these magicians! When the napkin is unrolled, the knife is found outside the fold and not inside where it should be.

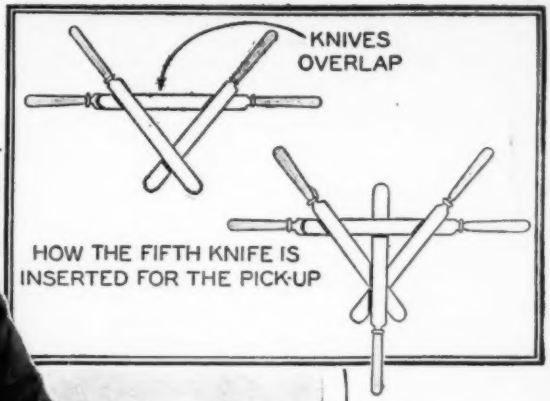
The secret is absurdly simple. When unrolling the knife you should unroll the outer corner of the napkin for one complete revolution by itself. Then, proceeding with the doubled napkin, you will eventually arrive at the knife, outside and not inside the folded cloth where it was originally placed. This will amaze everybody. Maybe!

Here's an easy one: It calls for five knives. The idea is to arrange four of them in such a manner that they can be lifted with the fifth knife. The photograph and diagram on opposite page show the "how." It's as easy as all that!

Another little catch of a similar variety

& Forks





Can you pick up four table knives with one? Sounds hard, but the stunt is easily done when the knives are arranged as shown in the above diagram. Try this stunt on your dinner guests—the chances are that unless they are familiar with the trick, they'll flunk miserably on it.

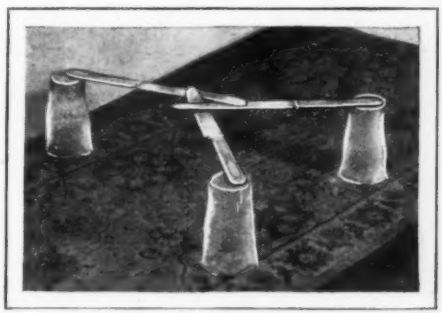
consists of arranging three tumblers in triangular formation and bridging them with three knives. A condition of the construction is that each knife must rest upon one tumbler only, and at one point. The bridge when finished must be firm enough to sustain a fairly heavy weight—say, a plate of the wife's best biscuits. The marvelous bit of structural engineering is fully explained by the photograph.

The Disappearing Spots

Get this one: The performer exhibits an ordinary table knife. "Nothing on this side." And, turning the knife over, "Nothing on this side." To each side of the knife, then, the magician affixes three small squares of paper, pressing them down at equal distances along the knife blade after first moistening them with his tongue. "Three on this side. Three on this side." Now for the trick. Proceeding systematically and efficiently, the performer commences to remove the small squares of paper, wiping them off with his left forefinger as he manipulates the knife with his right hand. "One from this side. One from this side. Another from this side. Another from this side . . ."

And, finally, "nothing on this side, nothing on this side," as the performer shows each side of the knife blade to be entirely innocent of paper covering. But . . . *mirabile dictu* . . . the performer requests a spectator to blow on the knife blade, and . . . Lo! . . . there they are again: "Three on this side! Three on this side!"

The solution of this excellent little effect lies in one deft movement of the right hand which can be easily mastered by anyone. To commence, dab on the three squares of paper to either side of the knife. Now,



Can you make a stout bridge out of three knives and three tumblers? This is another stunt which sounds hard but is really simple, as shown above.

This photo explains the secret of holding the knife in the mysterious trick of the disappearing spots described by Mr. Brown. The fingers are held so that the knife blade is given a half turn when the hand is turned over, and another hidden half turn by twisting the knife by the thumb.

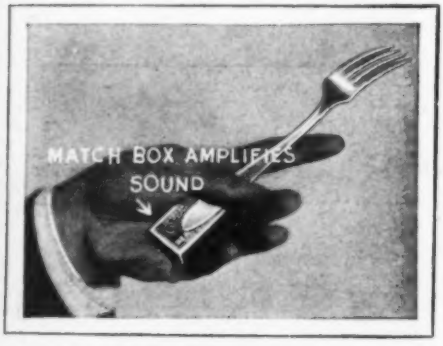
holding the knife in your right hand, remove one of the small squares, the tip one, with your left forefinger. The second move is to apparently turn the knife over and remove the corresponding square from the opposite side of the blade. What you do, however, is something entirely different—you turn the knife *completely over*, immediately brushing your finger over the empty space on the knife from which you have previously removed the paper square.

The "deft movement" before referred to has to do with this complete turn of the knife so that it will appear to the spectator as if the knife were but turned half way over. To do it you hold the knife in your right hand, as shown in the first photograph, palm up, thumb on the side of the knife handle. Now . . . take a knife in your hand and go through this slowly . . . if you will twist your thumb over, you can give the knife a half turn, as shown in the second photo. You will also find that if you turn your hand over so that it is palm down, you can give the knife an additional half turn, thereby making a complete revolution of the knife although the two movements, blended together with a little flourish of the hand, seem to be but the natural movement required to turn the blade over.

After making the complete revolution, the forefinger of the left hand immediately strokes the knife blade as if removing a square of paper. The second square of paper is then removed and the knife again turned completely over by reversing the movement—a pull with the thumb and a turn of the hand—and the forefinger again pounces down on the knife and brushes away an imaginary slip of paper.

When the three papers have been removed from one side of the knife in this fashion, you show the knife completely bare, and then, making only the half turn, you show the knife again housing three papers on one side; and then with the double twist you show three squares on the opposite side. The fingers of the left hand then close about the knife blade and apparently remove the three paper squares from either side.

Do you get it? It really is one of the most excellent bits of magic in existence, and not at all as difficult as all this haranguing would seem to indicate. Try it!



The concealed matchbox acts as a sound box in magnifying the vibrations of the fork handle after the prongs have been plucked and the original sound note has apparently died away.

An Amazing Sound Trick

This one has to do with "acoustics." Don't let the subject stop you . . . it's only Greek for playing the fool with sound. The performer places two tumblers on the table. He picks up a fork. He plucks the prongs of the fork with his fingers so that it gives out a sound, and after the sound has died away, he proceeds to pick it out of the air again and throw it into first one tumbler and then the other.

The whole basis of the thing is that the fork continues to "ring" for some time after the sound has apparently stopped, but *inaudibly*. If the butt end of the fork is gently touched to a solid object, however, the sound will at once become audible again, and the note given off in consequence is, by association of ideas, at once attributed to the glass. In an old form of this excellent trick, it was customary to touch the butt end of the fork to the table

Astonish Your Audience by Swallowing a Knife—Like This:

Wrapping the knife in a napkin, the performer permits it to slide to his knees, concealed by the table top. The knife is then produced from the vest.

top. A great improvement in the tone of the notes can be effected by concealing a small matchbox in your hand, as shown in the photograph, and using this as a sound box. The fork is held clear of the box until the initial note has died away, and then touched lightly to the box for the "plucked" notes which appear to come from the glasses.

This is the big, knife-swallowing act! The performer takes an ordinary table knife and rolls it in a napkin. Then, holding the end of the napkin to his mouth, he taps the opposite end gently and lets the knife slip down his throat. Right down! And then . . . a reproduction from the region of the vest line . . . and there you are!

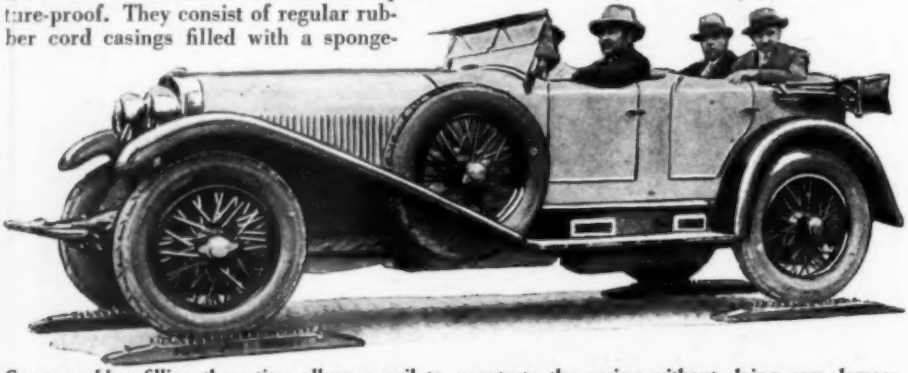
It's all very simple. The trick is performed at a table. The wrapping of the knife and all that is fair enough, but just before the knife is carried to the mouth, there is a brief moment when the mouth of the napkin is below the table top, and in that fraction of a second the knife is allowed to slip out and fall to the performer's knees, as shown in the photograph.

The swallowing then takes place, ending with the complete crushing of the napkin to show that the knife is "all gone." While the masticating process is going on . . . steel is "rawther" difficult, you know . . . the performer is cautiously busy with the task of pushing the knife up under his vest so that it can be later removed from the region of the middle button hole.

Although the performer seems to swallow the knife in the napkin, he actually slides it to his lap, hidden by the table edge, as shown. This maneuver is accomplished just before the "swallowing" takes place.

"Get Out, Get Under"—Maybe, But Not for Punctures

THE driver of this car doesn't have to worry about getting out and changing a tire after a blowout. The tires are puncture-proof. They consist of regular rubber cord casings filled with a sponge-like rubber substance instead of air. This material fits tightly inside the casing and contracts easily when a bump is hit.



Sponge-rubber filling these tires allows a nail to penetrate the casing without doing any damage.

Adopt Diesel Motors to Air Use

INCREASED economy and greater reliability of operation for aircraft are seen by aeronautical authorities in the recent adoption of Diesel engines to aviation.

The Packard Motor company is building a new plant for the development of their Diesel type motor. It is an air-cooled, radial type, which is adopted to the new cowling recommended by the National Advisory Committee on Aeronautics to lessen air resistance.

A number of other American engineering concerns are working on Diesel type engines for use in airplanes. The Diesel motor offers simplicity, safety and economy. Using inexpensive, low-grade oils, danger of fire is practically eliminated.

This kitchenette collapses like a folding screen and takes little space when not in use.

Spain Building 260-Mile Road

SPAIN is about to begin construction of a modern automobile road 260 miles long. It will enable tourists to complete the trip from San Sebastian to Madrid in a few hours. The roadway will be 36 feet wide. Curves will be wider and will be banked to allow speedy turns.

A Whole House in a Single Room

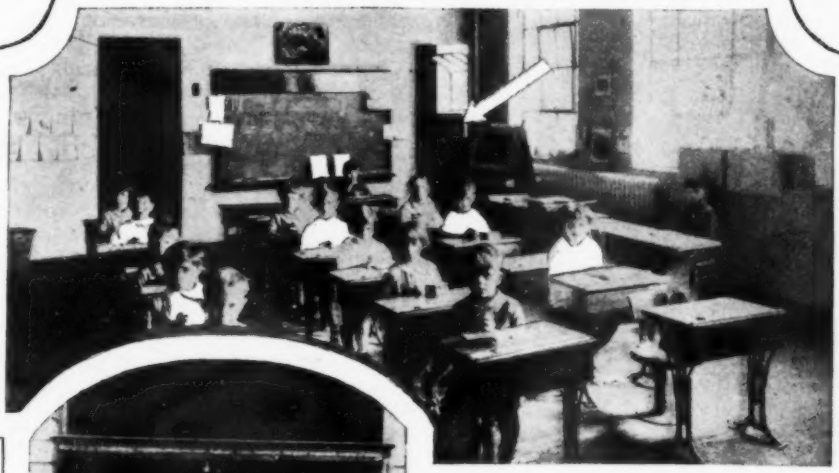
THE majority of a city's population living in one-room apartments is the prediction that has been made in regard to future urban life.

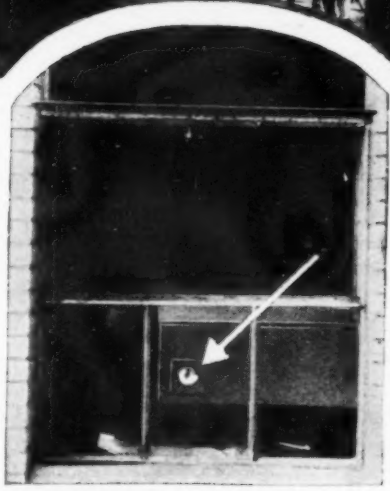
Beds, tables and other necessities of the home have been constructed to fold into the side of the wall, converting the room into a bedroom, library or dining room at will.

Now comes the folding kitchenette. It works just like a folding screen and contains shelves, towel racks, cupboards and all the equipment of a kitchen pantry. When not in use, kitchen may be placed in corner.

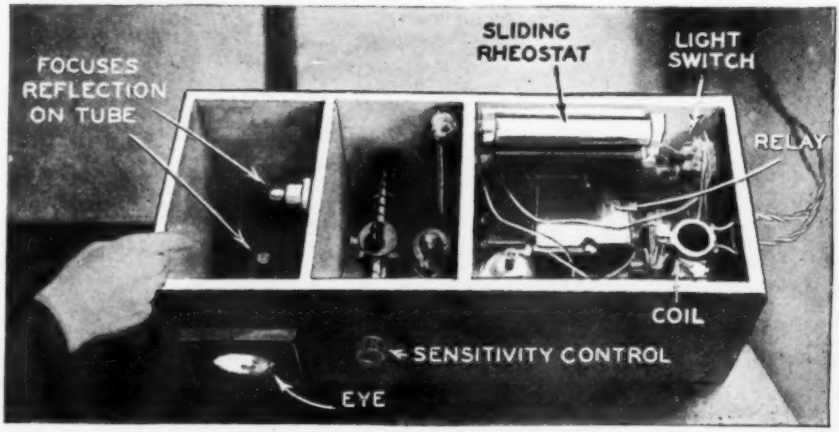
A small gas stove may be used when the kitchenette is open.

Electric "Eye" Automatically Controls Lighting in Rooms

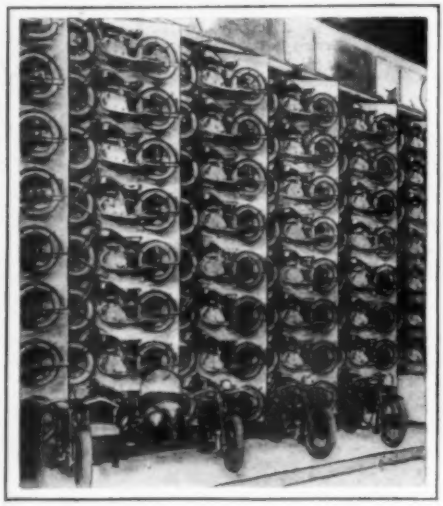




AN APPARATUS has been developed that automatically turns the electric light switch in a school room when shadows begin to darken the pupils' desks. The outside light is focused through an electric eye on a photo-electric tube which, when the light begins to fade, sets up contact with the switch by means of a relay. The "electric eye" is adjusted so that adequate light, natural or artificial, is constantly maintained.



500 Motorcycles Decorate Walls at German Auto Show

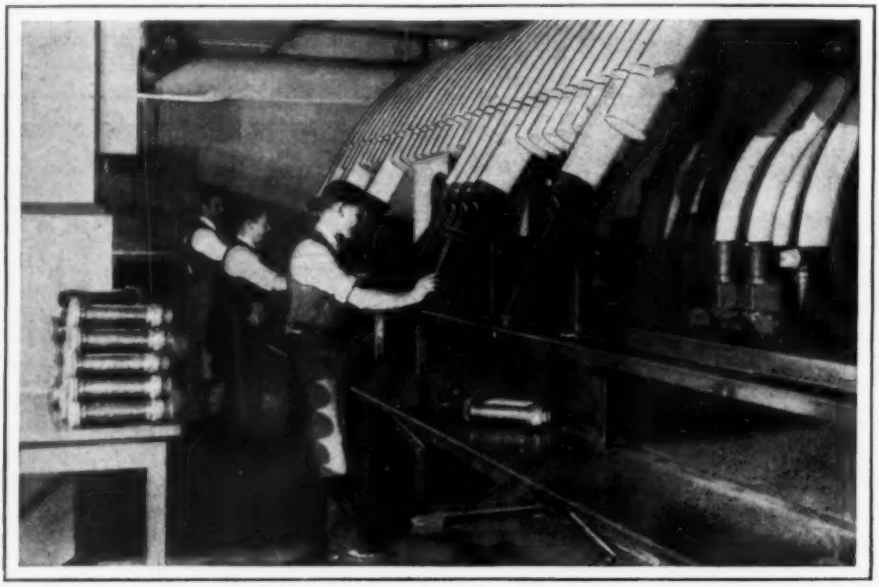


MOTORCYCLES by the hundreds covered the walls of the exhibition buildings at the recent Motor Show in Berlin. As shown in the photo at the left, the cycles were hung seven-deep upon the walls, with a row of machines fitted with side-car equipment occupying a ledge beneath. More than 500 motorcycles were used in assembling this unique exhibit. The purpose of the novel arrangement was to save expense because of the high cost of floor space.

Americans might think it peculiar to give so much emphasis to motorcycles at an auto show, but the two-wheeled vehicle is much more popular abroad than in the United States. Several factors combine to promote the popularity of the motorcycle, chief among which is the high price of gasoline, which averages fifty cents a gallon in most European countries.

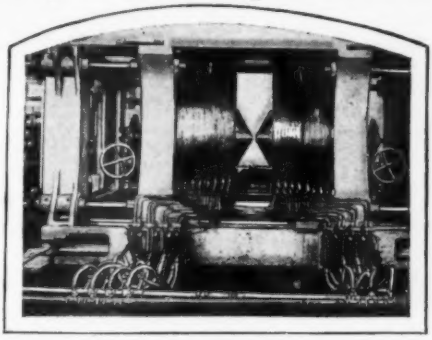
Pneumatic Tubes Carry Correspondence Through Office Building

INTER-OFFICE correspondence is shunted about from one floor to another with lightning-like rapidity, thanks to the pneumatic-tube system of transferring messages, recently installed in the new skyscraper of a New York insurance company. The various tubes shown in the photo below lead to different offices in the building. If a message from the fifth floor must go to an office on the twelfth, it is shot to the dispatching room shown in the picture, where attendants insert it in the proper tube and it is pneumatically delivered to its destination.



Largest Electromagnet Is Built by French Experimenters

AT THE right is pictured what is said to be the largest electromagnet in the world, constructed by the French physicists Maboult and Cotton for experimental purposes. It stands higher than a man. The projecting cones which may be observed in the center of the picture form the core of the magnet around which are wound countless coils of wire which, when charged with electric current, have the property of magnetizing the metal core. The magnet is used in studying magnetic fields and for similar experiments. Similar magnets, though not of such large size, are used commercially in lifting scrap iron and heavy machinery.

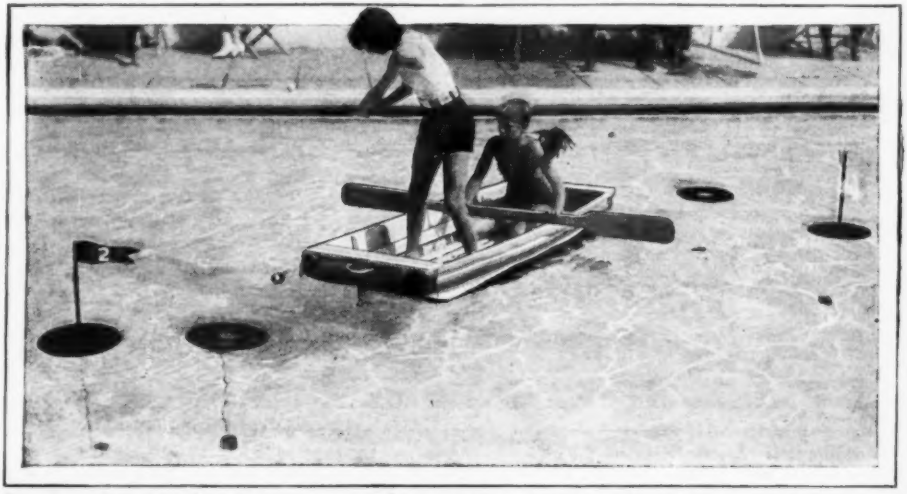


Sea-Going Golf Game

BATHING suits rather than knickers are regulation equipment in the sea-going golf game shown in the photo below. The caddy not only stands ready to produce mashie or niblick when wanted, but also officiates as gondolier of the tin boat while the player does her best to keep her eye on the ball, which is of the non-sinking variety. The "holes" are floating disks with a depression in the center into which the ball must be holed. The distance between holes isn't great, but according to some of the scores rolled up in this novel water game it's a whole lot better for the duffer's peace of mind if he restricts his golfing to dry land.

Machine Age Benefits Workers

THE common complaint that the modern age of machinery has made the skilled artisan a thing of the past does not seem to be borne out by a survey recently made of the various types of human skill required in this power age. The age of unintelligent robots who are mere tenders of machines is as far distant as at the beginning of the industrial revolution, if conclusions of experts that less than 4% of the population of the United States is engaged in work which binds the workman to the rhythm of the machine, are correct. Some of the modern types of skill are represented in accounting, stenography, chauffeuring, camera and motion picture work, flying, navigation, dentistry, surgery, laboratory research, tool-making, etc.



Water golf, in which the player strives to sink a golf ball into floating holes, is the latest sport.

Choosing Your Mechanical

By ORVILLE H. KNEEN

Mechanical refrigerators which operate by gas or electricity instead of ice are rapidly replacing the older type of ice-chest for domestic use. Mr. Kneen explains here the various operating features of several makes on the market, and shows how machines produce cold.

SOME seven years ago two young students at the Royal University of Technology, at Stockholm, Sweden, tackled for their thesis a problem which had long baffled science. They sought to devise a hermetically sealed device to remove heat from a refrigerator, without moving mechanism. Four years later each received $1,000,000 for their patented "cold-from-heat" process, now sold as the gas-operated Electrolux refrigerator.

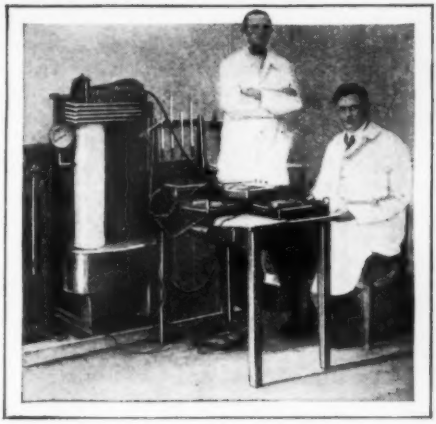
In this unique type of mechanical iceman a small gas-flame heats ammonia, absorbed in water. This drives off ammonia gas, which is condensed into liquid ammonia, the refrigerant employed by 90% of commercial cold storage plants. Mixed with hydrogen gas under pressure in the

This photo is representative of the new mechanical refrigerators, which in appearance vary to some extent with different makes, but which possess such common features as compact cooling coils and larger space for food than is afforded by ordinary ice-chests of similar size. Note how the operating mechanism is concealed out of the way. The machinery is automatically regulated.

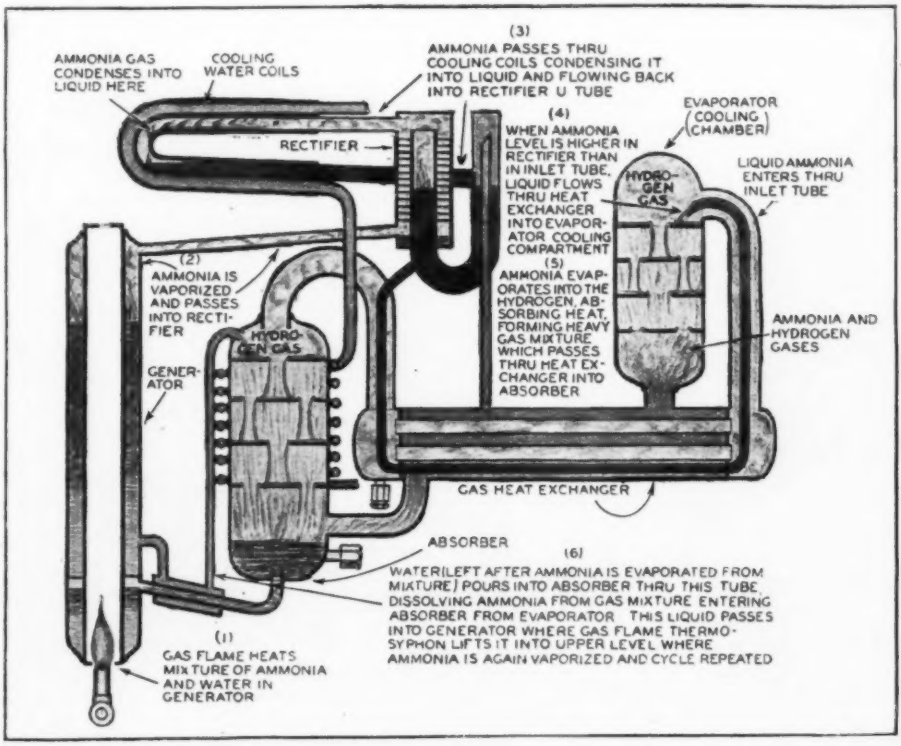
ICEMAN

evaporator, the liquid ammonia vaporizes (absorbing heat in the process) and the gas mixes with the hydrogen, to return to an absorber in which water dissolves the ammonia out of the mixture ready to repeat the cycle. The process may best be understood by studying the diagram below, which explains how the heat of a tiny gas flame can be transformed into cold.

The various sizes of Electrolux use from 1400 to 1800 cubic feet of gas a month, averaging $1.40 to $2.70; 400 to 500 cubic feet of water carries away the heat, averaging 50 cents a month or less. One company I interviewed gives free service for life, last year averaging two calls per machine. The units are expected to last indefinitely.



The two Swedish students who sold their invention of a gas-flame refrigerator for $2,000,000 are Baltzar von Platen (standing) and Carl G. Munters. The photo shows their invention, which is diagrammed below.


(3)
AMMONIA PASSES THRU COOLING COILS CONDENSING IT INTO LIQUID AND FLOWING BACK INTO RECTIFIER U TUBE
AMMONIA GAS CONDENSES INTO LIQUID HERE
COOLING WATER COILS
RECTIFIER
EVAPORATOR (COOLING CHAMBER)
(4)
WHEN AMMONIA LEVEL IS HIGHER IN RECTIFIER THAN IN INLET TUBE, LIQUID FLOWS THRU HEAT EXCHANGER INTO EVAPORATOR COOLING COMPARTMENT
HYDROGEN GAS
LIQUID AMMONIA ENTERS THRU INLET TUBE
(2)
AMMONIA IS VAPORIZED AND PASSES INTO RECTIFIER
(5)
AMMONIA EVAPORATES INTO THE HYDROGEN, ABSORBING HEAT, FORMING HEAVY GAS MIXTURE WHICH PASSES THRU HEAT EXCHANGER INTO ABSORBER
AMMONIA AND HYDROGEN GASES
HYDROGEN GAS
GENERATOR
GAS HEAT EXCHANGER
ABSORBER
(6)
WATER(LEFT AFTER AMMONIA IS EVAPORATED FROM MIXTURE) POURS INTO ABSORBER THRU THIS TUBE, DISSOLVING AMMONIA FROM GAS MIXTURE ENTERING ABSORBER FROM EVAPORATOR. THIS LIQUID PASSES INTO GENERATOR WHERE GAS FLAME THERMO-SYPHON LIFTS IT INTO UPPER LEVEL WHERE AMMONIA IS AGAIN VAPORIZED AND CYCLE REPEATED
(1)
GAS FLAME HEATS MIXTURE OF AMMONIA AND WATER IN GENERATOR

The two inventors who patented this idea for transforming the heat of a gas flame into cold, each received $1,000,000 for his share of the invention. The device employs ammonia and water and hydrogen gas in keeping refrigerators cool. The entire mechanism is set in operation by the gas flame.

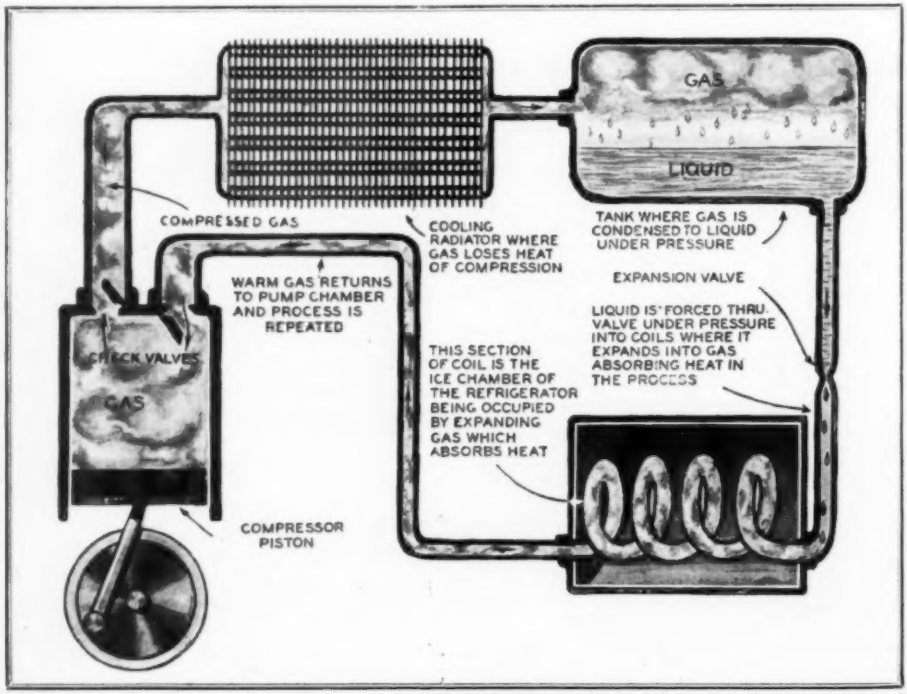
The gas-operated refrigerator is a distinct departure from the usual type in which an electric motor rather than a gas-flame supplies the operating mechanism. How does the conventional type of iceless unit work? The diagram on this page gives a clear idea of how gas is compressed into liquid by an electric pump and suddenly released from pressure to expand into gas once more, absorbing heat in the process. Sulphur dioxide, methyl chloride, or other gas is enclosed in a leak-proof system. Compressing the gas into a liquid causes it to become highly heated—remember how hot the barrel of the bike pump used to get?

In the condenser coils the heated liquid loses its heat to outside air or cooling water; usually air. The cooled semi-liquid is then suddenly released through an expansion valve. As it is highly atomized, it turns very cold, and from the brine tank (which takes the place of the ice-cake) absorbs the heat collected from the refrigerator interior. This heat vaporizes the semi-liquid into a gas again; it is drawn into the compressor, and the cycle is repeated.

All iceless units are made automatic by a thermostat, or "thermometer switch," which turns on the motor whenever the food compartment gets a degree or two warmer. The machine stops when the excess heat has been removed, and 45 to 50 degrees is maintained on only six hours daily running, on an average. The refrigerant, a mere carrier of heat, is never replenished.

Although this principle has long been known to science, it has proven very difficult to construct a self-regulating fool-proof machine which will start and stop itself at required intervals. Early thermostats sometimes failed to break the mercury contact and the motor kept running. In one unit where this happened, several ginger-ale bottles blew up, while other foods froze solid in the 16-degree "cold-wave." That does not happen today.

Each of the leading electric designs has noteworthy features. Thus the Rice has no float or expansion valve, and 25 years of experience in the cold-storage field has en-


GAS
LIQUID
COMPRESSED GAS
COOLING RADIATOR WHERE GAS LOSES HEAT OF COMPRESSION
TANK WHERE GAS IS CONDENSED TO LIQUID UNDER PRESSURE
EXPANSION VALVE
WARM GAS RETURNS TO PUMP CHAMBER AND PROCESS IS REPEATED
LIQUID IS FORCED THRU VALVE UNDER PRESSURE INTO COILS WHERE IT EXPANDS INTO GAS ABSORBING HEAT IN THE PROCESS
CHECK VALVES
GAS
THIS SECTION OF COIL IS THE ICE CHAMBER OF THE REFRIGERATOR BEING OCCUPIED BY EXPANDING GAS WHICH ABSORBS HEAT
COMPRESSOR PISTON

This cross-sectional view shows the type of cold-producing mechanism in use on the majority of iceless refrigerators. Sulphur dioxide is the gas commonly employed. The gas is compressed into a liquid and forced through an expansion valve where it is suddenly free to expand into its normal gaseous state. In doing so it absorbs heat in much the same manner as a melting cake of ice.

abled it to eliminate a number of parts.

The General Electric has sealed in all moving parts in a steel case set on top of the cabinet. Installation consists simply of plugging in to the nearest socket. The entire unit is replaced in case repairs are needed, and no oiling or motor is required.

The Copeland is unusually speedy in freezing ice cubes and desserts, as is the Rice and Electrolux. One size of Copeland freezes 108 cubes at once, and some desserts are frozen in an hour, others in four or five.

The Kelvinator's cooling unit is at least ten degrees cooler, the company states, than the cake of ice it replaces—the latter's melting surface being 32 degrees. One owner of a Kelvinator told me he had had no trouble of any kind in five years. The latest model has further reduced the noise, although to most people the muffled hum of the average motor and compressor is not objectionable.

The Frigidaire, made by General Motors, has a new "Cold Control," whereby six degrees of cold are obtained by turning a dial, to hasten or retard freezing of desserts, salads or ice cubes.

Two other machines well received by authorities are the Welsbach and the Absopure. The latter was developed by the former "ice king" of a large city.

How cold are common ice chests? A. Crawford Craig, one of the country's best-known authorities, told me of a series of tests on ice chests, in which the best were found to be only 30 degrees cooler inside than out, the worst but 22 degrees cooler. An 80-degree kitchen—common enough—would raise the interior to 50 or 58 degrees, with a moist heat ideal for germ propagation.

In this country today, even in the hottest of hot waves, over 731,000,000 cubic feet of cold-storage space is maintained mechanically at 0 to 44 degrees. But in the home there was no such machine until about 14 years ago the Kelvinator company began its endeavors to build an automatic unit. We have been a long time devising protection at the last and most vital point in our food's journey from field to stomach.

By 1924, in homes where radios and cars and comforts abound, there were only some 140,000 iceless refrigerators of all makes. Then interest began to awake. The number

This iceless refrigerator, of the gas-operated type, combines the services of ice-chest and gas range.

doubled, doubled again, until today there are believed to be about a million in use every day in the year. At least half a million are expected to be placed this year.

The demand for improved sanitation and better health have helped the iceless machines. They have no odors or slimy deposits, no germs unavoidably carried in with ice. Moisture is inevitable with ice, and it aids bacteria and corrosion. In iceless machines moisture from food collects as frost on the cooling unit. Once a month the motor or gas flame is turned off and the frost melts and drops into a pan for removal.

Rounded corners and porcelain or enameled finish, make cleaning easy, inside and out. The floor space is either covered or entirely open. Metal casings, welded joints and airtight construction, with tight doors and replaceable door-gaskets, insure sanitation and insulation. No iceless machine has less than 2 inches of corkboard, the minimum for keeping out summer heat; several have 2½ and most have 3 inches.

Power cost is from $3.00 to $3.50 a month, for an average of 40 to 45 kilowatt-hours. Against this cost, for most families but little more than for ice, are economies such as saving of food spoilage; larger food storage because cooling unit takes only about half the space of ice, permitting shopping when prices are low.

Garden Dirigibles Eclipse Old Type of Chimney Sweep

This huge vacuum cleaner, shown above, frees chimneys, pipes and furnaces from soot and grime in a short time.

DAYS of the old chimney sweep who wormed his way up or down a grimy flue are fast waning. This giant vacuum cleaner, shown at left, is one of the reasons why. It takes soot from the furnace, pipes and chimney by suction.

After it has finished its cleaning, the air is permitted to escape and the bag fastened to the truck and carted off to the next job. It carries the dirt away with it.

Eliminate Errors of Copying

PHOTOGRAPHIC registration of deeds and important documents, supplanting laborious and sometimes inaccurate copying, is saving the taxpayers of Wayne county, Mich., several hundred dollars daily, according to Otto Stoll, county registrar.

At cost of $6,000 Mr. Stoll arranged for the installation of two photostatic machines that would record both sides of legal documents. Today the machines are quietly doing their work in an office that formerly echoed with the clicking of 33 typewriters. Three of the typists are retained, however, for recording instruments that are too indistinct to photograph.

The photographic record includes all stamps and fingerprints — in short, a facsimile of the original, except for color.

Flags Control Plane Traffic

IN ORDER that plane traffic to and from a Los Angeles airport may be regulated from the ground, a new flagging system has been inaugurated. Display of a red flag forbids landing, a white flag signifies the field is clear, a green flag means to land at once.

Explore Oil Fields With Radio

PROSPECTING for oil through the medium of radio was recently authorized by the Federal Radio Commission. Twelve licenses were granted for this purpose to the Interstate Geophysical Explorations company, operating in Texas, Louisiana and New Mexico.

Radio waves will be used to sound the nature of the geographical structure. They will also serve as means of communication.

Teach Young Russians Science of Building Model Airplanes

SOVIET RUSSIA is not going to be "left on the ground" in the future. Youths of tomorrow are being trained in construction and operation of airplanes. Pupils of the Raditchew school for Technical Science in Moscow are shown in the photo below learning how to build model planes of different types.

These Russian boys are learning how to build models of various types of airplanes flown today.

Bike Racer Travels Many Miles Without Going Any Place

HUNDREDS of miles without going anywhere! That's the way Sewall, well known bike racer, trains at home. He is shown in the photo at right using the apparatus which permits him to sprint, coast and glide in his backyard.

The cyclometer on the front fork of the frame registers many hundreds of miles that the racer has traveled on the rollers. By constant training on this machine, the rider is able to keep his legs in proper shape for the grueling grind of a six-day race.

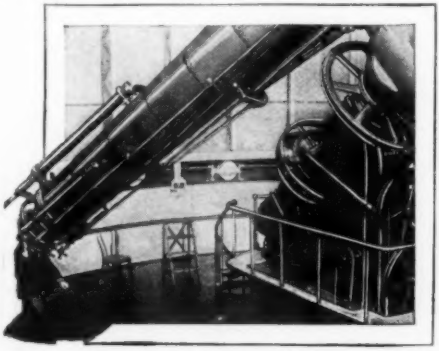
Apparatus allows bike racers to train in backyard.

Huge Telescope Scours Heavens

CHANCE discovery of a small boy during the 16th century has evolved into this huge telescope, shown below, mounted in the Naval Observatory, Washington, D.C.

The son of a Holland spectacle-maker, the youth one day picked up a lens in each hand and looked through them at a church spire. He was astonished to see the steeple greatly enlarged and ran to his father with the news.

The father repeated the experiment, noting the varied view he obtained by moving the lens. He fixed two lenses to a board



and displayed his findings to his neighbors. Thus was the first telescope invented.

Planets and stars millions of miles away can be seen through the monstrous telescope in the Washington Observatory. Accurate account is kept of their positions and any change would be noted at once.

Prof. Asaph Hall is shown in the photo above sitting before the eye piece of the telescope, which is 26 inches in diameter. The huge instrument is extremely delicate.

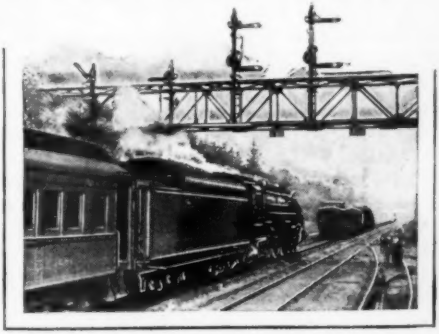
New System Eliminates Wrecks

EVEN if a locomotive engineer should pass the danger signals or become incapacitated at his post, disaster can be prevented by a system of electric inductors placed at intervals along the rails on all the New York Central lines.

A device is attached to the lower portion of the tender on all locomotives. Each inductor is connected with the signal system nearest it. If the danger signal is picked up by the receiver on an engine's tender as it passes over the inductor, air brakes are automatically thrown on, and the train is brought to sudden halt.

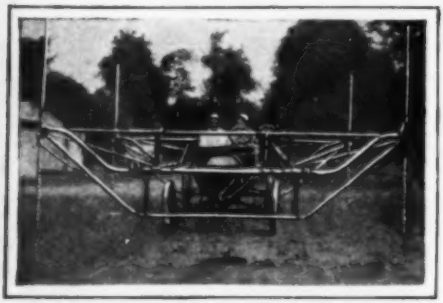
After a train has been stopped by this automatic control, it can not start again until a human hand resets the inductors.

This system will be especially valuable when trains are running close schedule.



Train passed signal and was automatically stopped.

Invents Machine Which Drills 4 Blasting Holes a Minute



TIRED of boring one hole in the ground at a time for the purpose of loading with explosives to shatter the soil in order to plant trees, dig ditches, etc., on his farm, a man near Taylorville, Ill., recently invented a machine with which four holes can be drilled at the same time.

The apparatus consists of a set of light, tubular-hinged trusses which rest on the chassis of an automobile. The ends of the frame are fitted with gear-driven heads to operate the augers for drilling.

Wright Brothers Awarded D.S.C.

ORVILLE WRIGHT'S modest, "Thank you!", when Dwight F. Davis, now ex-Secretary of War, placed a Distinguished Service Cross on his breast, was voiced so low that he was required to repeat it a second time to make a record for sound motion pictures being taken of the ceremony.

The cross, which is granted to civilians only by a special act of Congress, was awarded to Mr. Wright and posthumously to his brother, Wilbur Wright.

"By his vision, perseverance, courage and skill," Mr. Davis said, reading the Congressional citation, "he, in collaboration with his brother, Wilbur Wright, designed, constructed and operated the airplane which at Kitty Hawk, N. C., Dec. 17, 1903, made the first successful flight under its own power and carrying a human operator—thereby making possible the achievements which are now stirring the emotions and pride of the world."

"Thank you!" said Mr. Wright. That was all.

Color Aids Truck Advertising

AMERICA'S current demand for color has extended to designs of motor trucks. Manufacturers have decided that it is not merely a whim, but arises from a sound, economic basis like other forms of advertising. Because of their size, large trucks cleverly decorated have been found to be one of the best advertising mediums.

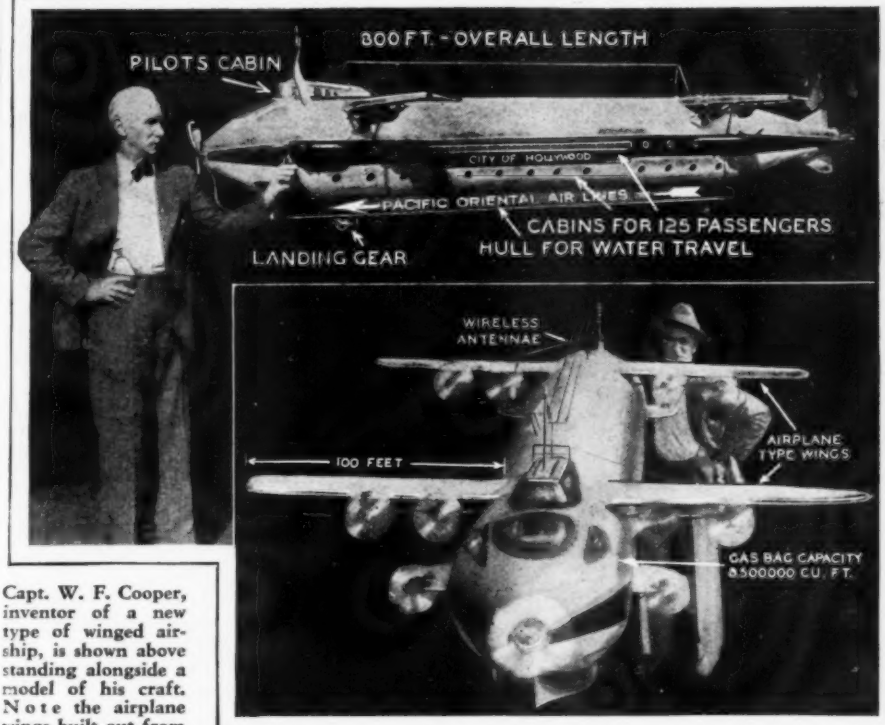
Mechanical methods of applying paint, as with spray guns, have greatly cheapened the cost of applying color to trucks. Lacquer finishes such as Duco, which dry within a few minutes after application, make it possible for trucks to be refinished rapidly so that they need not be kept long out of use.

Sound Focused Into Air by Horns

SUPER-DIRECTIONAL horns, which focus sound in the same manner that a flasher focuses light, will be placed in the four corners of airfields in the future to guide planes in landing in a fog, if predictions are realized. The horns are 20 feet in length and 10 feet wide. In a recent trial with the Navy dirigible, *Los Angeles*, the crew heard the sound plainly.

Sound horns will guide planes to field in fog.

A New Dirigible with Wings



Capt. W. F. Cooper, inventor of a new type of winged airship, is shown above standing alongside a model of his craft. Note the airplane wings built out from the gas bag.

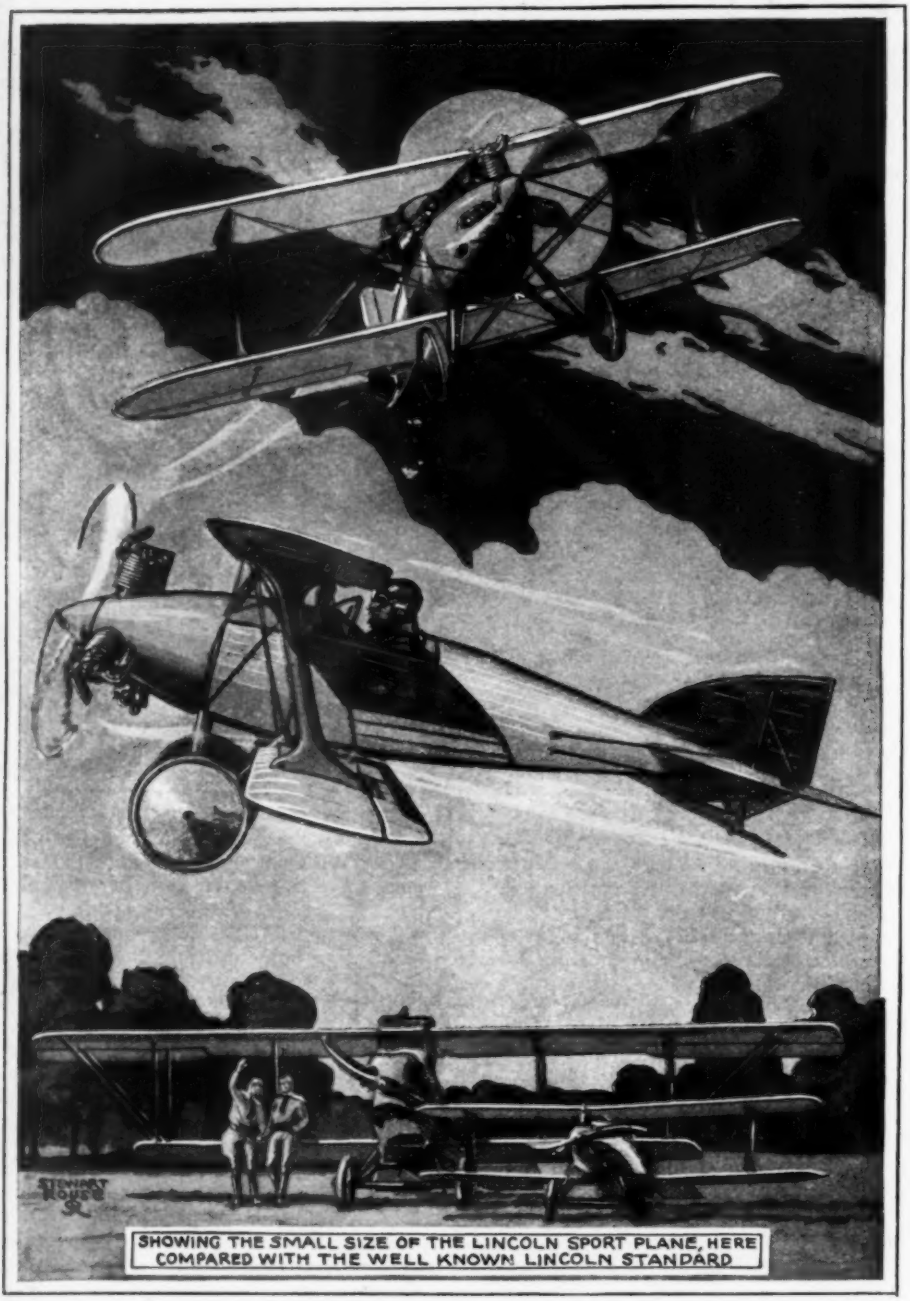
INTENDED to revolutionize air and sea travel, a novel amphibian airship which combines various features of Zeppelin, airplane, and ship construction has been designed by Capt. William F. Cooper of Los Angeles, Cal. The model of his airship which is shown in the photos above is one ninety-sixth the size the air-liner will be when completed. With a wing spread of 200 feet, a length of 800 feet, and a gas-bag diameter of 135 feet, the airship will be the largest and most unusual craft ever to take the air.

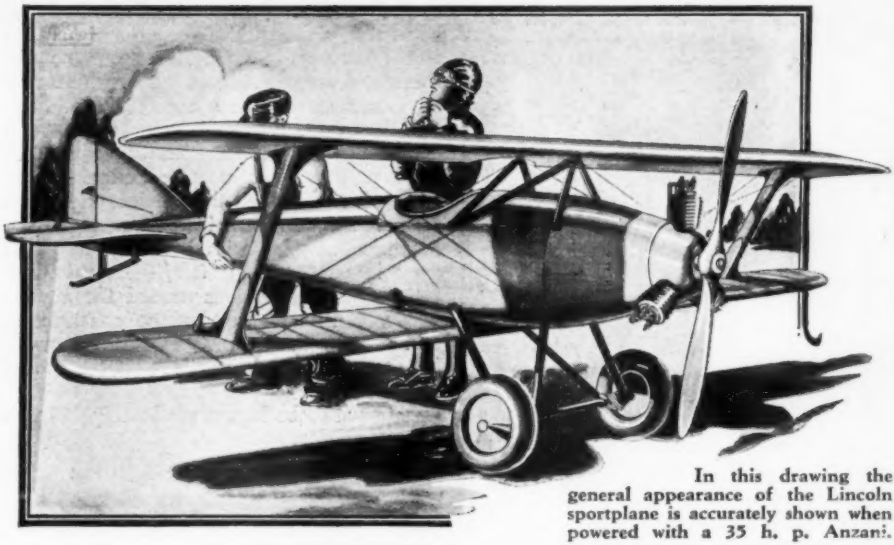
The most striking feature of the airship is the arrangement of airplane wings in combination with a rigid gas-bag. These wings are intended not only to give added lifting power to the ship, but they also serve as mounts for the motors and thus the inventor is able to do away with the engine gondolas which hang below the gas bag in such rigid airships as the *Los Angeles* and *Graf Zeppelin*. Wheeled landing gear is designed to permit the ship to land on the ground in much the same fashion as an airplane.

The amphibian airship is equally at home on water as on land, for its hull is designed for travel on the surface of the sea when desired, at a rate of speed far in excess of ordinary ocean liners. Thirteen propellers, driven by seven motors, comprise the power plant. The twin propellers on the wings are driven by single engines geared up to drive them in pairs.

A crew of 25 and a passenger list of 125 will be accommodated by the ship. Helium gas—8,500,000 cubic feet of it—will be used in filling the gas bag. Radio, smoking rooms, and other travel luxuries are promised the passengers in his ship by Captain Cooper. The inventor was formerly an Alaskan mail carrier.

This Small Biplane Climbs and Flies the Same as Its Bigger Sisters





In this drawing the general appearance of the Lincoln sportplane is accurately shown when powered with a 35 h. p. Anzani.

Building the LINCOLN BIPLANE

Performing in the same fashion as a modern commercial ship this time-tried light plane design is the editors' answer to the requests of readers who have wanted a "hot performing" one place sport biplane.

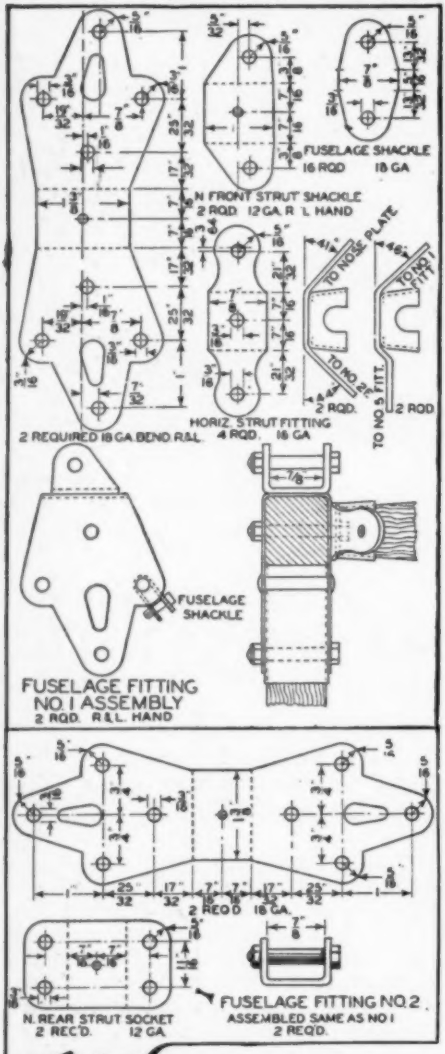
THIS article takes up the general layout and constructional features of the Lincoln Standard Sportplane, a biplane of diminutive proportions which has been on the market as a knocked-down set of construction parts for several years. The makers, The Lincoln Standard Airplane Co., of Lincoln, Nebraska, have sold several hundred sets of parts, and the writer has seen and personally inspected the ship built to these specifications by Mr. Fred Trump, formerly of Minneapolis, and now connected with the Keystone Aircraft Works, Bristol, Pa.

The ship is eminently safe, with a factor of safety of 11 to 1, or about 100% in excess of the U. S. Department of Commerce present day specifications for type certificate airplanes.

Though the ship was designed several years ago, and stands today a time-tried design of from four to five years of age, it has back of it the designing experience of the firm which built the famous Lincoln Standard war-time planes. Powered with the new Henderson 35-h.p. F-head air-cooled four-cylinder motor, or with the rebuilt Lawrence, in which a two-throw crankshaft is substituted, the ship would have between 70 to 80 miles per hour speed, would fly a useful load of about 225 lbs., and have a ceiling of about 8,000 feet. With the three-cylinder 35-h.p. Anzani, which swings a big prop at a comparatively low speed, the ship will have about a 100-mile speed and about twice the climbing power and ceiling with the same useful load.

Frankly speaking, this article is not for the rank novice. It contains completely dimensioned plans, in this and the following two installments, and general hints on the building of the ship. To tell exactly every move to be made would require a book the

Details of Fuselage Fittings


FUSELAGE SHACKLE
16 RQD 18 GA
N FRONT STRUT SHACKLE
2 RQD 12 GA R & L HAND
TO NOSE PLATE
TO NO 3 FITT.
2 RQD
HORIZ STRUT FITTING
2 REQUIRED 18 GA BEND R&L 4 RQD. 16 GA
FUSELAGE SHACKLE
FUSELAGE FITTING NO 1 ASSEMBLY
2 RQD. R & L. HAND
2 REQ'D 16 GA.
N. REAR STRUT SOCKET
2 REC'D. 12 GA.
FUSELAGE FITTING NO 2
ASSEMBLED SAME AS NO 1
2 REQ'D.

The details of some of the fittings are herewith shown to give a good idea of the staunchness of the little ship. The use of sheet steel is plainly noted.

size of this issue of MODERN MECHANICS, and even then would presuppose some knowledge of aircraft construction on the part of the builder.

However, any bright lad who has access to the experience of a licensed pilot can build this plane with the occasional help he is able to receive from the pilot, and the completed ship will be safe and reliable in the extreme if the plans are followed to the dot. For those who wish blueprints, a five-dollar bill sent to Lincoln Standard Aircraft will bring a neat, complete set of prints, which though they give no more information than shown in the working drawings here, may help when it comes to actual shop layout. This article, then, furnishes all working dimensions needed for anyone fairly familiar with airplane construction to build his own plane. It is not an a-b-c how to build article, nor is it intended to be such.

In general the layout of the ship is interesting.

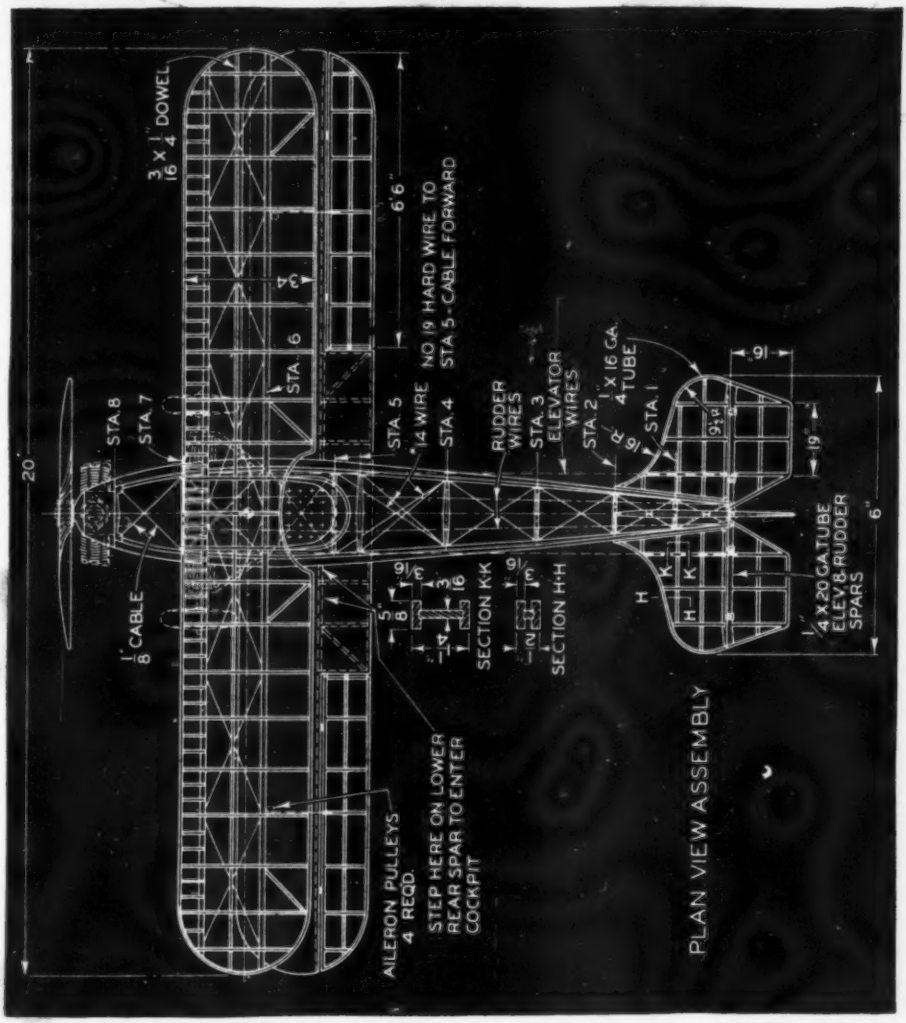
Here are the main characteristics:
Span, ft.—20
Wing section—U. S. A. 27
Length o. a.—16 ft.
Stagger—15½ ins.
Weight empty—370 lbs.
Weight full load—600 lbs.
Wing loading—51½ lbs. sq. ft.
Power loading—17 lbs. h. p.
Power—28-35 h. p.
Max. speed—90-100 m. p. h.
Cruising speed—75 m. p. h.
Range—250 miles
Climb—800 ft. per min.

This article covers merely general procedure. As there is not enough room to run the full set of plans in one issue of MODERN MECHANICS, with this installment some of the drawings for the details are included, together with the plan layout. This will enable the reader to get a good fundamental idea of the ship. Each succeeding article gathers up the remarks and details of what has gone before until with the last the reader has the full set of plans.

It will be seen that the gage used in the fittings of this ship is readily obtainable at the ordinary tinsmith's or blacksmith's shop. The fittings for the most part are very simple and are made of cold rolled sheet steel. When working these in the vise, the proper method is to cut them to shape, drill them and then do the bending. There are some holes, of course, which would be best to work into the bent shape and then drill so that the holes for bolts are in line.

You can see from the wash in the front of this article that the size and general layout of the Lincoln Sportplane are diminu-

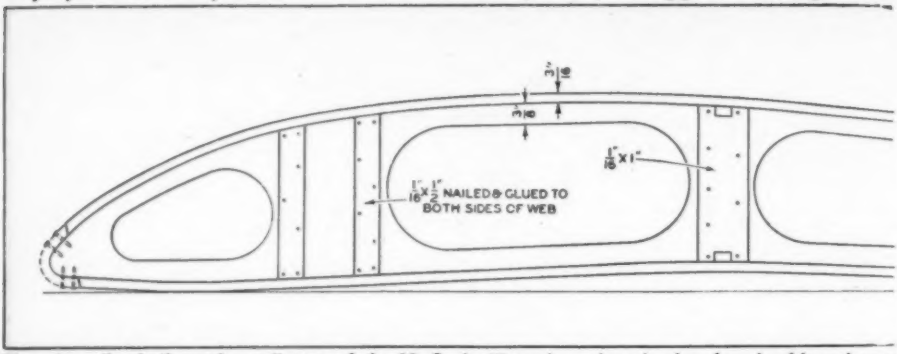
Plan Blueprint Shows Trim Ship of Conventional Biplane Type



This blueprint shows the layout of the Lincoln Sport Biplane, which will travel 100 m. p. h. with a 35 h. p. Anzani, and which can be built by anybody from the plans published in this series. The main dimensions are given herewith with the details of the stabilizer ribs.

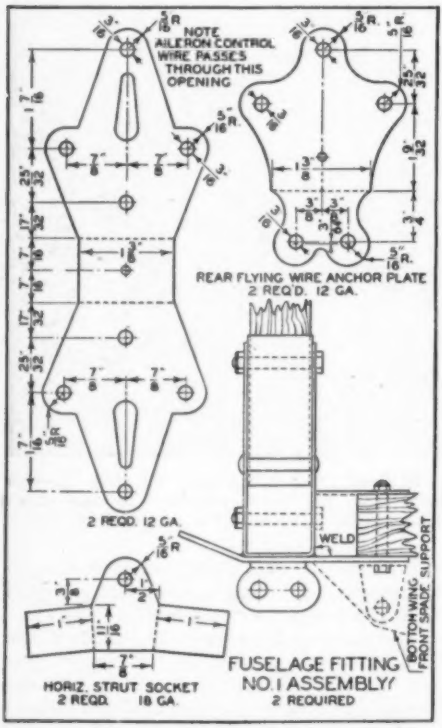
tive and conventional. The plan drawing as shown in the blue print gives, to scale as far as layout is concerned, and the location of the parts, the overhead layout. The fuselage is of wood and wire construction, with $\frac{7}{8}$x$\frac{7}{8}$ longerons trussed with number 14 wire. Forward the trussing is the usual $\frac{1}{8}$ flexible wire. The fuselage tapers both in plan and form, and instead of the usual vertical tail post, the post is horizontal. This makes for finer streamlining and a ship which resists the torsional effects of rough handling a little better.

The fuselage longerons are bent to shape in a jig which is made out of rough lumber. It takes the form of a bow with the top side curved to the shape of the bottom of the fuselage. To this the lower longerons are clamped. Then the fittings for the struts are installed, the struts themselves fastened,



The wing ribs, built to the ordinates of the U. S. A. 27 section, given in the plans in this series on the construction of the Lincoln Sportplane, are of the conventional solid wood type.

and then the top longerons are bent down to the fittings placed on the top of the struts. They are fastened and then with the use of the turnbuckles the whole fuselage is trued up. It is faired with pads along the struts and small strips of spruce running along the pads.


NOTE AILERON CONTROL WIRE PASSES THROUGH THIS OPENING
REAR FLYING WIRE ANCHOR PLATE 2 REQ'D. 12 GA.
2 REQD. 12 GA.
WELD
BOTTOM WING FRONT SPADE SUPPORT
FUSELAGE FITTING NO. 1 ASSEMBLY 2 REQUIRED
HORIZ. STRUT SOCKET 2 REQD. 18 GA.

Fittings of the wing clips for fitting the wings to the fuselage are shown in half part here. The article gives hints on bending of sheet metal.

Now in this installment you will notice a drawing which shows the peculiar and clever interplane strut which is a Lincoln feature. Not only is it aerodynamically good, but because it is a solid piece, with the 1½ degree decalage built in, the ship requires practically no truing other than the tightening of the flying and landing wires. This strut, two of which are required, is made up of spruce as the drawings indicate, and before gluing all the parts are carefully fitted and sanded. Use Curtis cold water glue for this strut, clamping with the well known type of shop clamp until the job is good and dry, after about a week's setting.

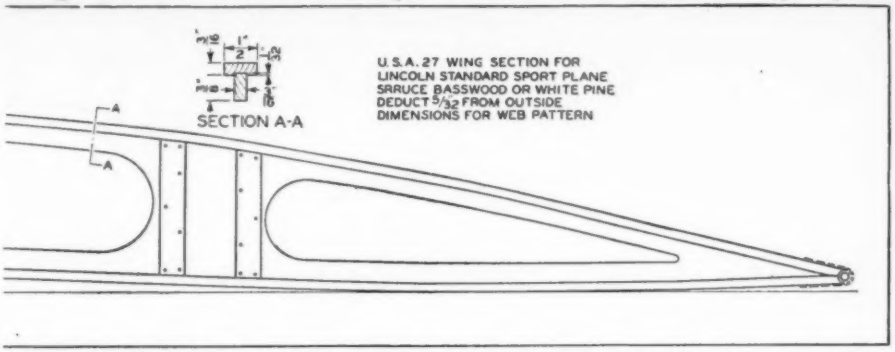
You will notice from the plan view that there is a ¼ inch dowel running through the wing ribs. This is to steady the ribs and keep them from vibrating between spars.

Note the respective directions of the grain in the struts.

With the fuselage done and the struts made, according to these and subsequent details, the landing gear struts can be made. These are of steel tubing and can be worked as shown in the long vertical blueprint, which gives all the details of the parts for the landing gear, short of the wheels and and shock cord, which can be installed by anybody. These wheels, by the way, can be purchased from the Lincoln Standard people.

Near the ends of the tubes triangular cuts are taken as shown, using the hacksaw. The ends are bent together and are oxy-acetylene welded.

Wing Ribs—U. S. A. 27 Wing Section Used on Lincoln Sportplane

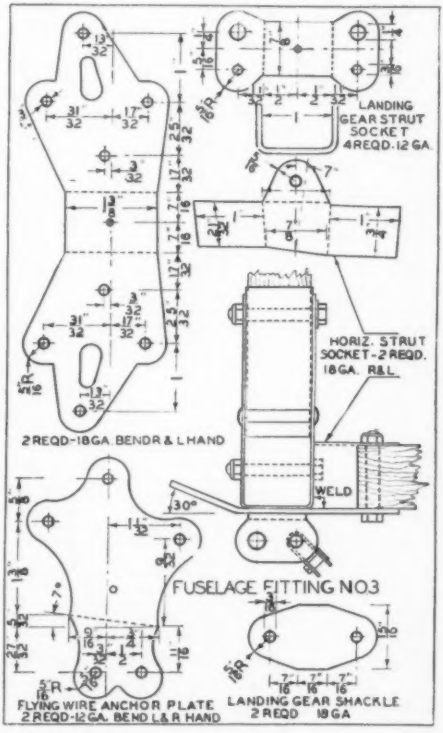


The better way to make the wing ribs is to cut one to shape as taken from the ordinates, making a template which can be tacked over a group of ribs so they may be cut to one size.

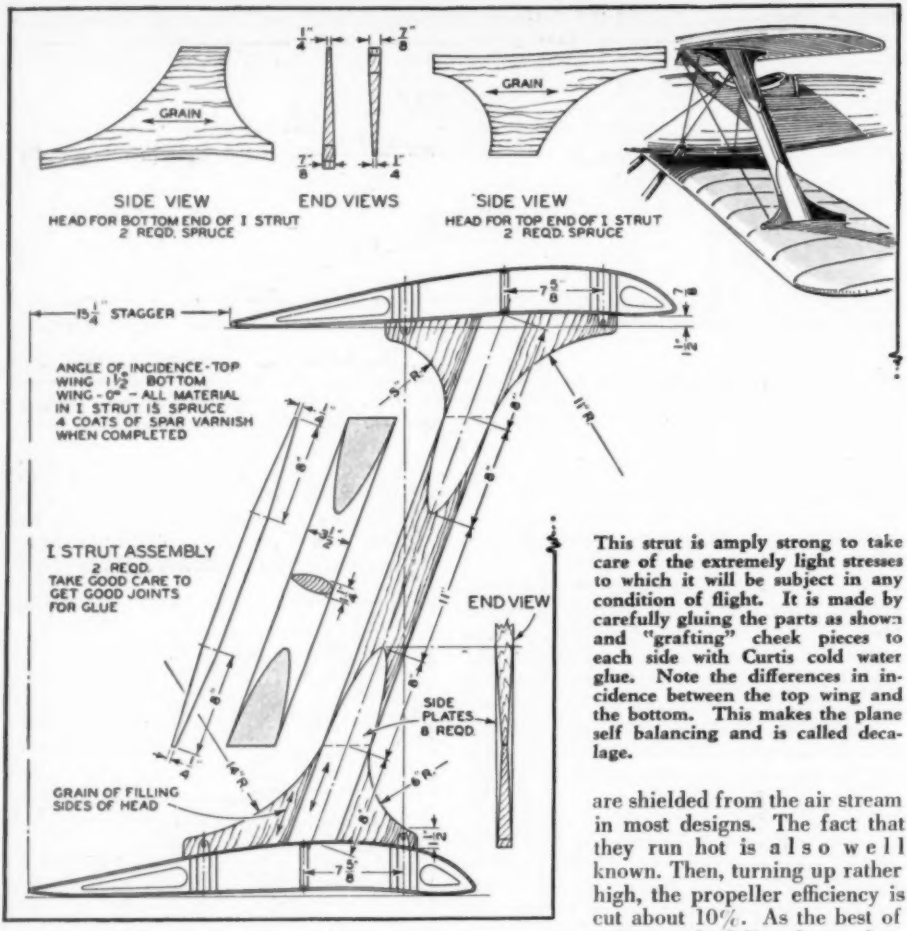
The wing ribs are built as shown, to the standard U. S. A. 27 wing curve. This comes on a further sheet of the plans, as does the wing curve, and shows the ordinates to use for the curve. The drawing shown with the relative sizes of the woods used, gives a clear idea of the type of wing rib used. This is the old, time-tried, strong method of making them out of solid wood and lightening them a little. Such ribs are as heavy as those used in the Jennies and Standards of wartime days, and are far stronger in proportion to the loads which will be imposed upon them, so there is little to worry about on this score.

The wing ribs are built by making a master template, and then tacking together all the thickness of wood for one wing, which is 16 thicknesses in the upper wing and 18 in the lower wing. The lighten holes are all drilled through what will appear to be a solid block of wood, and then light cuts are taken where the spars come. This will mark the spar hole both on the top side and the bottom side, but on four points if the cuts are properly made, and then the cap strips can be put on. This is the best way to make them and will require no jig. The little 1-16 inch tabs are put alongside the spar holes where the down rod goes through, and the rib when given a coat of varnish or two after having been sanded, will be ready to slip on over the spar.

The plans for an airplane seem to be so incoherent until they are all together in one spot, that it is extremely hard to run a how-to-build in split up fashion. However, several details are run in here which must be considered in the building of the ship, and the cutlines will classify them for the subsequent part of the story. Until next month then, gang, make yourselves familiar with


LANDING GEAR STRUT SOCKET 4 REQD. 12 GA.
HORIZ. STRUT SOCKET - 2 REQD. 18 GA. R&L
2 REQD-18 GA. BEND R & L HAND
WELD
30°
FUSELAGE FITTING NO.3
FLYING WIRE ANCHOR PLATE 2 REQD-12 GA. BEND L & R HAND
LANDING GEAR SHACKLE 2 REQD 18 GA

The anchor plate for the flying wires is placed under the vertical and horizontal strut socket.


GRAIN
SIDE VIEW
HEAD FOR BOTTOM END OF I STRUT
2 REQD. SPRUCE
END VIEWS
GRAIN
SIDE VIEW
HEAD FOR TOP END OF I STRUT
2 REQD. SPRUCE
15 1/4" STAGGER
ANGLE OF INCIDENCE - TOP WING 1 1/2° BOTTOM WING - 0° - ALL MATERIAL IN I STRUT IS SPRUCE 4 COATS OF SPAR VARNISH WHEN COMPLETED
I STRUT ASSEMBLY
2 REQD.
TAKE GOOD CARE TO GET GOOD JOINTS FOR GLUE
END VIEW
SIDE PLATES 8 REQD.
GRAIN OF FILLING SIDES OF HEAD

This strut is amply strong to take care of the extremely light stresses to which it will be subject in any condition of flight. It is made by carefully gluing the parts as shown and "grafting" cheek pieces to each side with Curtis cold water glue. Note the differences in incidence between the top wing and the bottom. This makes the plane self balancing and is called decalage.

the details here presented, getting a clear conception of them, so that next issue they will fit into the scheme of things.

As regards motors for all the light planes which have been published in MODERN MECHANICS, much may be said. There are several types of motors from which the builder may make his choice—V-twin, two-cylinder opposed, etc.

The use of the motorcycle V-twin is not particularly commendable as this writer sees it. When you stop to consider that the average V-twin motorcycle engine develops under ideal conditions on a test stand but 25 h.p., and that for but short periods, it is unreasonable to ask these little motors to develop more than 15-20 h.p. under ideal flying conditions. For one thing, the valves are shielded from the air stream in most designs. The fact that they run hot is also well known. Then, turning up rather high, the propeller efficiency is cut about 10%. As the best of props rarely deliver better than 75% efficiency, it can be seen that the best the propeller can deliver to pull the ship around is about 12 h.p. The motorcycle motors are a bit light for anything save the lightest of ships, such as the Irwin Meteorplane. The Lincoln Sportplane is considerably stouter and needs a stronger motor. The Heath, the Russel, and the Lincoln will not fly well with the V-twin motorcycle types.

The light engine which is available to everybody is the Henderson. The new Hendersons deliver about 35 h.p. with their new valve arrangement as presented in the 1929 model motorcycles, and with the Heath base, which allows a lot of oil for cooling the motor in conjunction with its lubricating functions, it will make a very good light

airplane motor. As remarked in the December, 1928, issue of MODERN MECHANICS and in the Flying Manual published by this magazine, the motor can very easily be converted with the addition of a thrust on the end of the crankcase housing and the shaft for coupling the crankshaft to the prop hub. The Henderson will give the light planes published in this series the same performance as most of the OX5 commercial planes, being loaded about the same weight per horsepower.

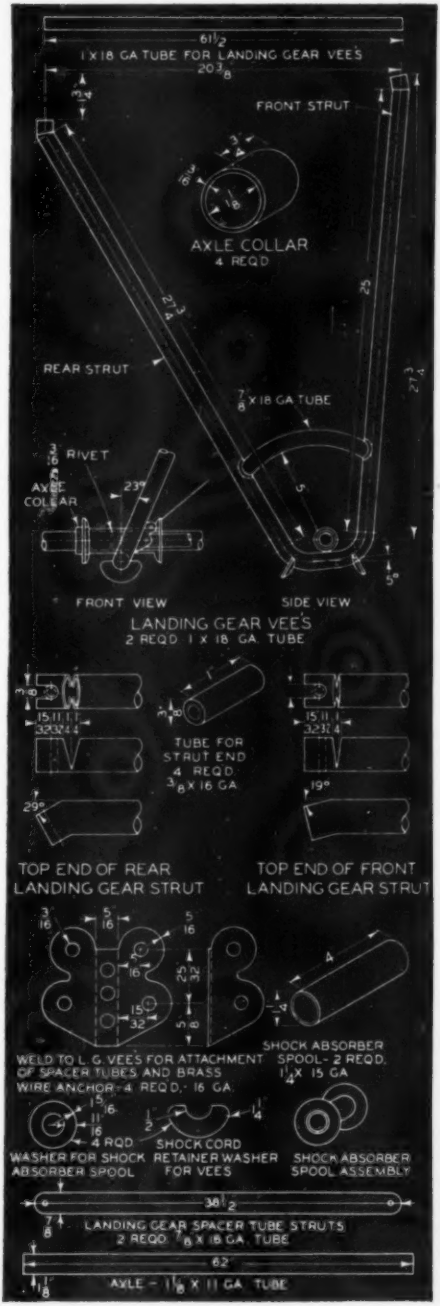
As to the Lawrence engine, it is not recommended. The motor was built as a hurried wartime design with a single throw crank, and vibrates too much to allow it to be held in a ship for very long. The servicing problem is a bitter one with this engine. However, by building a two throw crank, and substituting a special cam, they can be made into a fairly serviceable opposed motor. By the time, however, that you get them in shape, you will have spent a lot of money.

The Irwin is a fine little two-cycle engine, but costs $650 at the makers' plant, in Sacramento, California. It is light in weight and will fly any light plane. The two-cycle engine seems to be the coming solution to light plane motors.

The Anzani 35-h.p. motor, with which the ship in this article is powered, is made in France, and imported into this country by Henry Lowe Brownback and associates, of Norristown, Pennsylvania. There are a number of these in the second-hand market and a well-placed want ad will generally bring the required result. These sell for $700 new — a bit out of reach — and for from $200 to $300 second hand.

As a matter of interest to those aeronautically inclined, let us say that with the power mentioned the Lincoln Sportplane should perform beautifully with the floats which we have had Sam Rabl design, and which can be used with the Parasol, Baby Bullet, or the Russel Henderson, or the Lincoln Sportplane.

Next month a further series of the unusually complete plans for the Lincoln Sportplane will be published, and until then it's "adios!" The editors all wish that more room could be given the plans and description of this plane, but so many good things were calling for space, and the plans for the Lincoln are so unusually complete we have to put some of this good dish on the shelf for the future.


1 X 18 GA TUBE FOR LANDING GEAR VEES
FRONT STRUT
AXLE COLLAR
4 REQD
REAR STRUT
7/8 X 18 GA TUBE
3/16 RIVET
AXLE COLLAR
FRONT VIEW
SIDE VIEW
LANDING GEAR VEES
2 REQD 1 X 18 GA TUBE
TUBE FOR STRUT END
4 REQD
3/8 X 16 GA
TOP END OF REAR LANDING GEAR STRUT
TOP END OF FRONT LANDING GEAR STRUT
WELD TO L G VEES FOR ATTACHMENT OF SPACER TUBES AND BRASS WIRE ANCHOR - 4 REQD. - 16 GA
SHOCK ABSORBER SPOOL - 2 REQD. 1 1/4 X 15 GA
4 RQD
WASHER FOR SHOCK ABSORBER SPOOL
SHOCK CORD RETAINER WASHER FOR VEES
SHOCK ABSORBER SPOOL ASSEMBLY
LANDING GEAR SPACER TUBE STRUTS
2 REQD 7/8 X 18 GA TUBE
AXLE - 1 1/8 X 11 GA TUBE

Full dimensions for landing gear metal parts.

Saw Mounted on Swinging Arm Adjusts to Any Angle

This radial saw allows sensitive regulation of feed

DEVELOPMENT of the radial drill idea has been applied to the rotary saw shown in the photo at left. This saw can be adjusted to any height of cut, any angle of swing or any position for mitering.

It is mounted on a motor suspended in a track on an adjustable radial arm, and is fed into the work by hand. This method allows for sensitiveness in regulating feed of cut.

The saw is run by electricity and is easily operated. With this adoption, it is possible to cut pieces of wood at angles that would be impossible with another type of saw.

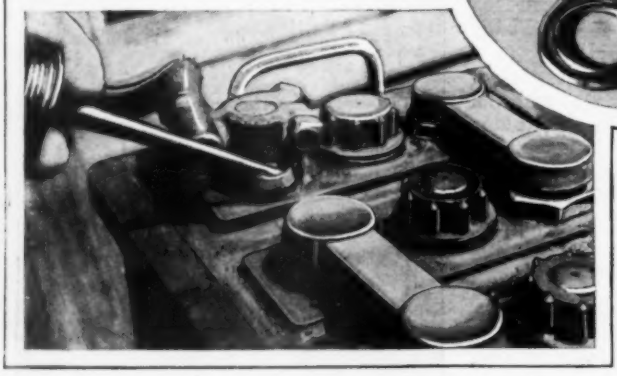
A guard protects the hands and prevents any obstacle from touching the whirring teeth of the blade except where it is actually sawing wood.

Guiding is done by means of the handle on the swinging arm.

Refrigerators Help Air Menu

DRY ice refrigerators are the latest addition to the comforts of air travel. This adoption makes possible the serving of meals en route on a journey in the air.

Nothing more than solidified carbon dioxide, dry ice is particularly suited to airplane use because of its slight weight. Coastal Airways, Inc., have announced that this type of refrigerator has been installed on all of their planes.



Storage batteries may be kept clean of corrosion with adoption of the device shown above. Oil rings are placed about the terminal posts and are filled with engine oil about once a month. The oil serves to insulate the connections.

Keeps Posts Free From Corrosion

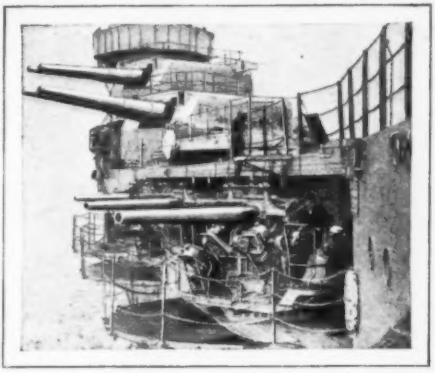
DESIGNED to prevent corrosion on storage batteries, this device has been developed by J. F. Anderson, Akron, O. It consists of a lead ring which fits around the battery terminal post, and a felt washer lying on top of the ring. A cup-shaped projection and groove in the ring form an oil reservoir. The ring and washer are placed under the battery terminal, and engine oil is added.

Aircraft Carrier Equipped With Guns to Thwart Bombers

THE U. S. S. *Lexington* not only carries airplanes, but it is also equipped with guns to shoot down enemy planes. In time of war, if enemy bombers come too close to the *Lexington* they will be taking their lives in their hands.

These anti-aircraft guns shown at the right have an effective range of more than four miles—almost straight up in the air—higher than any bombing plane would fly.

The operating gunners have established quite a reputation in the United States Navy in recent trials. Their scores have been comparatively high in practice. The guns are so mounted that they can easily be swung about to follow a fast moving object.



Refine Alcohol From Sugar Cane

OFFICIALS of 27 sugar cane mills in San Salvadore expect to use alcohol refined from surplus sugar to run their plants as a substitute for gasoline. The alcohol will be used as fuel for the motors and is expected to provide a great saving.

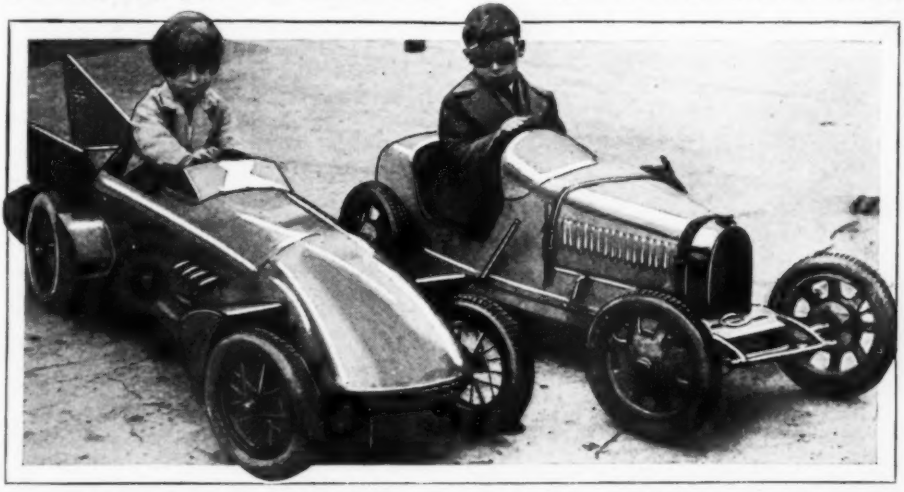
Rid Gophers to Aid Landings

POCKET GOPHERS versus aviators. That's how they lined up recently at the Douglas airport in Arizona. Scores of the rodents at the airport threw up thousands of little mounds of earth, making landing on the field extremely difficult. They were eradicated by the supervisor of rodent control of the Dept. of Agriculture.

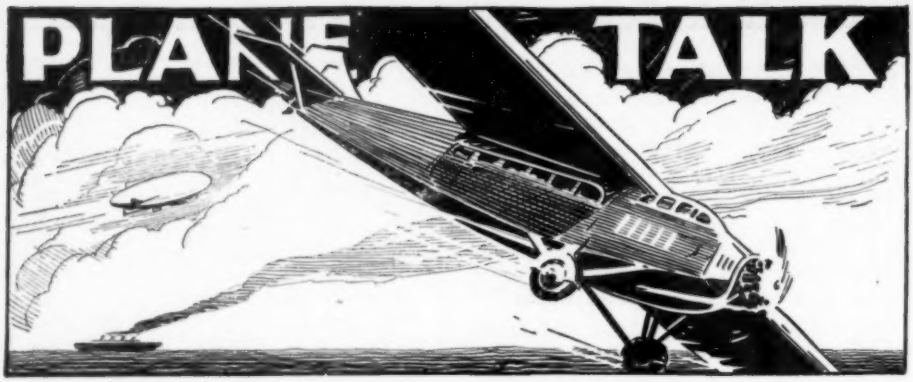
These Two Youngsters Are Out to Steal Their Dad's Racing Laurels

FOLLOWING in their dad's footsteps seems to be the thing these two youngsters, shown below, enjoy most. They are the children of Captain Campbell, English auto racer. The photo was taken at their home in Horely, England, while they were driving about in their yard.

Donald's car is an exact model of a Buggatti. It will travel at a speed of 18 m. p. h. Jean's car is a model of a Bluebird.



Donald and Jean, Capt. M. Campbell's children, shown in their racers which are electrically driven.



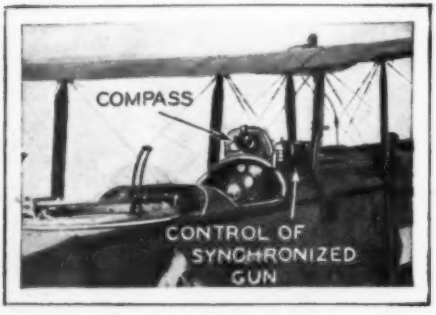
Edited by MAJOR H. H. ARNOLD

As one of that distinguished company of men who were present at the earliest government demonstrations of the Wright biplane before Army authorities, Major Arnold ranks as an aviation expert who has been "in the game" since its infancy. During the World War he was assistant chief of the American Air Service, and is now a flying officer of the Army. His department is a regular feature of Modern Mechanics.

Camera Guns Instruct Cadets in Aerial Sharpshooting

A PLANE diving at the rate of 250 or 300 miles an hour, engine open, machine guns spitting out bullets at the rate of 600 per minute—that is the picture which writers constantly picture for readers. It is an exciting moment, one that makes the readers get quite a thrill, but how many of either the writers or readers can visualize the mechanism which permits the aviator to get hits instead of misses?

It is not an easy operation to throw that spray of bullets into a small circle thirty inches in diameter or into a sleeve three feet in diameter and fifteen feet long. The thirty-inch bull's-eye is stationary on the ground and the sleeve moves through the air at a rate of about one hundred miles an hour. In either case the slightest movement of the plane will throw the bullets off.



The type of machine gun shown above is mounted rigidly to the fuselage and is aimed by controlling the direction of the plane. The firing mechanism is synchronized to fire between the propeller blades by means of an attachment on the motor camshaft. The plane aims the gun.

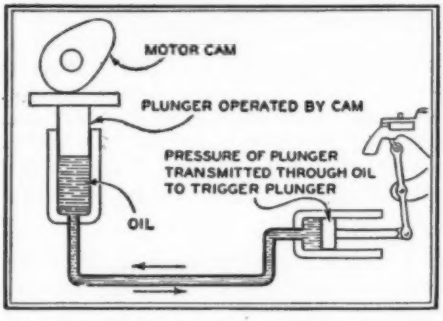
There are two kinds of guns on airplanes, classified according to the method of mounting them—synchronized and flexible. The synchronized guns are mounted rigidly to the fuselage. The whole plane is moved to get the guns on the target. Thus the pilot aims his plane to put the line of fire where he wants it. The guns have a mechanism so arranged and attached to the engine that it is impossible for the gun to fire when the blades of the propeller are directly in line with the stream of bullets.

The most modern of these synchronizing devices is mechanically connected with the camshaft. This permits the gun to be so timed that it can not fire when a blade of the propeller and the bullets will meet. Needless to say, such timing requires the most careful adjustment and inspection of the synchronizing gear and the ammunition. If the ammunition is bad and hangs fire, it means a hole through the propeller.

The speed of the bullet leaving the muzzle of the gun is 2,700 feet per second. It travels the six or eight feet from the muzzle of the gun to the arc of the pro-

peller in about one three-hundredths of a second. Meanwhile the propeller is rotating about 1500 to 1800 revolutions per minute. Thus, at a distance from the centre of the prop where the bullet passes, the propeller is traveling at a rate of 37,000 linear feet per minute or a little over 600 feet per second. From this it can readily be understood that every thousandth of a second counts and the slightest inaccuracy in adjustment of the minutest amount of wear in the system will cause a prop to be hit.

The flexible guns are fired from movable mounts. This does not require any synchronization with the engine. Care must be taken, however, that the gunner does not inadvertently hit parts of the plane. A moment of inattention may cause a burst to

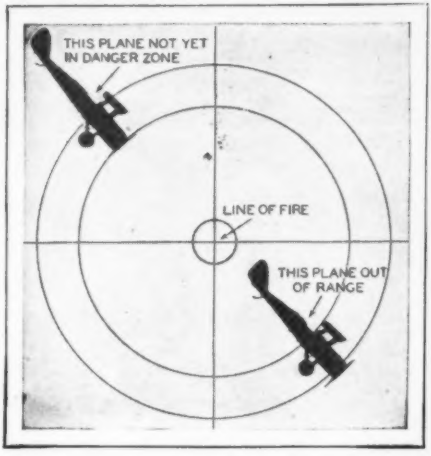


This diagram shows how gun is synchronized with motor.

shatter a control surface or wing with disastrous results.

The difficulty with flexible gun firing is that normally the gunner's plane is traveling one direction while the target may be traveling at right angles or in the opposite direction. Both may be traveling at over a hundred miles an hour. Accordingly there is quite a problem to determine the relative speeds of the gun and the target. Fortunately the wind vane sight automatically corrects for the relative speed.

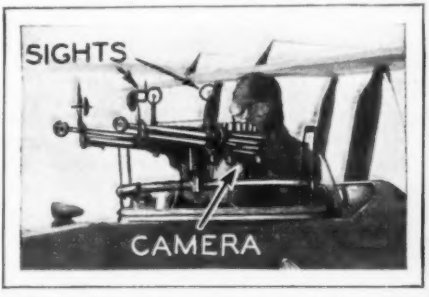
The wind vane sight consists of small plane surfaces so arranged that they assume an offset position relative to the muzzle of the gun. The offset distance varies with the speed of the plane. The bead of the sight is mounted directly above the metal surfaces. Thus the relative speed of the gunner's plane and the target is automatically



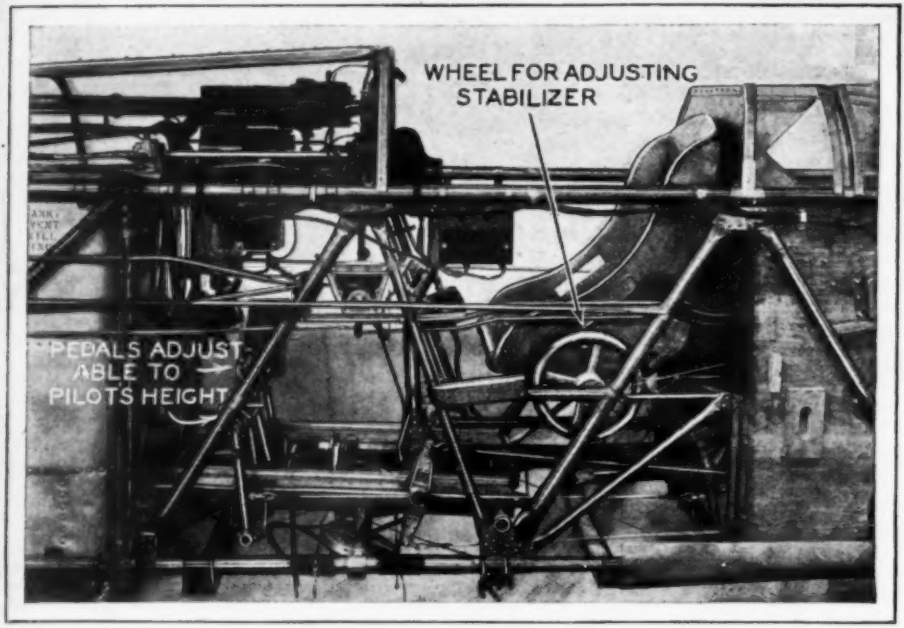
Above is a photograph taken through an airplane machine gun loaded with a camera instead of bullets. When the plane gunner pulls the trigger, a photograph is taken which shows whether or not a hit would have been scored.

taken care of. As the speed of the plane increases the distance from the gun muzzle to the sight bead increases and similarly the distance decreases when the airplane speed decreases.

To demonstrate to pilots and gunners exactly where their bullets would strike moving targets, a gun camera has been developed. This camera is mounted on the ordinary gun mounts. Every time the trigger is pulled, a picture is taken. The picture when developed shows the location of the target with respect to the line of fire of the gun. When the photos are examined, due allowance is made with regard to the direction of motion and speed of the target.



This is the machine gun camera which took the picture reproduced at the top of this page. Note how the camera has been mounted in the place usually occupied by the ammunition drum.



This is a view of the left side of the pilot's cockpit in a Curtiss Falcon. The machine gun installation may be seen convenient to the pilot's right hand. Note the tubular type of fuselage construction.

Up-to-Date Plane Fuselage Adjustable for Flying Loads

PICTURE a muddy airdrome with two airplanes coming in to make a landing. One apparently makes a perfect landing and yet, when it should take to its wheels and run along the ground, it hesitates, the tail flies up and over it goes on its nose. The other plane makes exactly the same kind of landing and yet rolls along through the mud with apparently no tendency to nose over. What is the difference between the two planes?

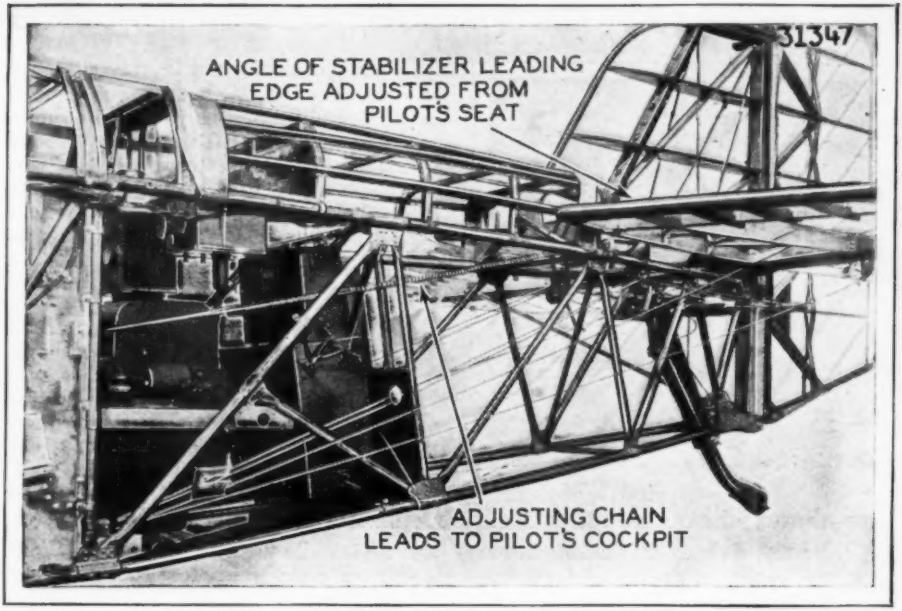
There may be many differences, but the landing gear has considerable effect upon the tendency of a plane to nose over in soft ground or in high vegetation. It required several years to develop the split type landing gear now used on almost all modern planes. The increase in size of wheels and tires, the elimination of the many wires and struts which formerly braced the wheels and the addition of efficient shock absorbing devices have made landing in mud, snow and high vegetation entirely practical.

Modern shock absorbing systems on landing gears have done much to eliminate crashes due to bad landings. With the hydraulic absorbers it is now possible to drop planes from distances of ten to fifteen feet above the ground without any damage to the plane.

As might be supposed an airplane in flight is very carefully balanced by using wing flippers, rudder and elevator. The rudder and flipper balance, once obtained, varies very little. On the other hand the elevator balance varies considerably with every hour flown. The centre of gravity of most planes is located just forward of the front cockpit.

Several years of experience in flying were necessary before engineers realized that the varying weight carried by a plane could be compensated for by providing a movable stabilizer. Today most planes have stabilizers hinged so that the pilot can change the angle and make take-offs easier, make another change in the air to get proper fore and aft balance, and then still another change just before landing to make the plane come down on the expected three points.

Another very important attachment usu-



This view is a continuation of the fuselage pictured on the opposite page. Note how the chain control leads to the wheel at the left side of the pilot's seat, permitting the leading edge of the stabilizer to be raised or lowered as the load being carried may require. A camera is mounted at the left.

ally found on an airplane is the radiator shutters. While it is but very recently that the automobile engineers have installed shutters on cars, airplanes have been using them for several years. The temperature drops very rapidly as the higher altitudes are reached.

It may be said that the most efficient temperature for airplane engines is about 80 to 85 degrees centigrade. Obviously this small range of temperature can not be maintained with an open radiator under all flying conditions. In the summer while flying at fairly low altitudes, temperature changes give the pilot little worry but during the other months of the year and while flying at high altitudes the shutters in front of the radiator are most essential. For instance, Capts. Street and Stevens flew for quite some time in a strata of air with the thermometer reading 60 degrees below zero centigrade. The effect of such cold upon the water in the engine cooling system can be imagined, had there been no shutters.

There was a time when the distance between the seat in the cockpit and the rudder pedals was practically constant in all planes. Thus it was that the pilot with long legs and the one with short legs both suffered while taking long flights. One, from having his legs doubled under his chin, became quite leg weary and the short fellow strained himself while trying to stretch his legs to reach the pedals. An inspection of the interior of airplane cockpits will now reveal an adjustable pedal to accommodate long, short, or medium legged pilots.

SHUTTERS FOR MOTOR TEMPERATURE CONTROL
OPEN SPACE BETWEEN WHEELS FOR CLEARING GROUND OBSTRUCTIONS
LARGE WHEELS AND TIRES

Front-end view of a plane with late type split landing gear. The absence of an axle makes it possible to clear obstructions on the ground, such as stumps or small hummocks.

Youth Paddles 9 Hours to Cross Swiss Lake in a Washtub

A double paddle makes sailing a washtub easy.

WASHTUBS may not be very attractive looking vessels, but records can be established in them. The young man shown in the photo at the left was in the process of making one when the picture was snapped. He paddled his tub for 9 hours before he reached the other side of Lake Lucerne, Switzerland. Two companions accompanied him as a matter of safety.

Lever Turns Plane Into Glider

A MONOPLANE that drops its motor and gas tank to become a glider when the engine fails was recently constructed at the Oakland Municipal Airport. By pulling an emergency lever in case of motor failure or fire, the motor and gasoline tanks, carried as an undersection, drop away.

"Vagabond" Shop Supplies Isolated Summer Resorts With New Books

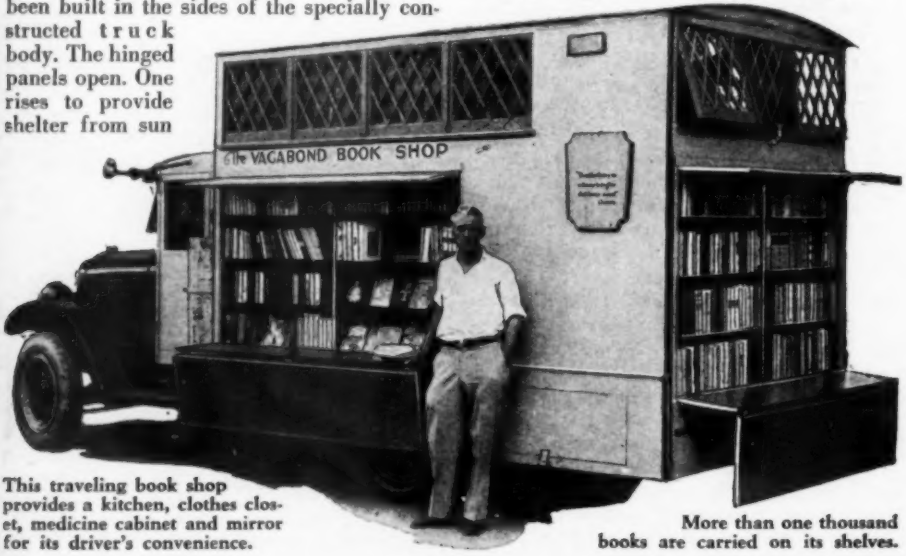
LITERARY needs in fashionable but far distant resorts are provided for by this traveling book shop, shown in the photo below. This movable shop parks in some shady corner of a summer resort where books usually consist of the Bible and a school history of the United States. Its stock comprises popular fiction, classics and rare volumes of all natures.

The shop is equipped with a writing desk and dining table for the driver.

Tin-lined, weather-proofed shelves have been built in the sides of the specially constructed truck body. The hinged panels open. One rises to provide shelter from sun and rain, while the other two drop to form a counter from which to serve customers. The shelves on each side hold 250 volumes and the racks in the rear take care of 500 books.

The shop is owned and operated by Frank Collins, Carmel-by-the-Sea, California. Its interior has French windows to provide light and ventilation for Mr. Collins' living quarters. It is also equipped with a radio.

A built-in couch, with a pullman berth above, occupies one side near the front.

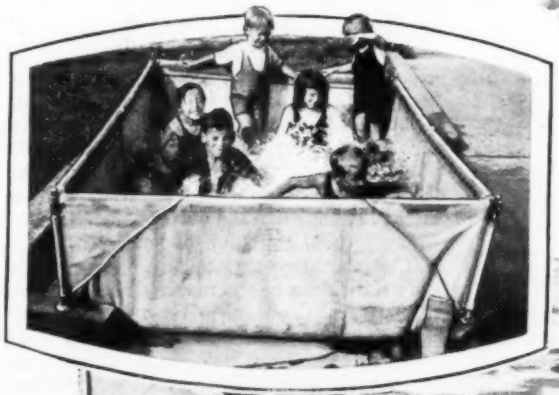


This traveling book shop provides a kitchen, clothes closet, medicine cabinet and mirror for its driver's convenience.

More than one thousand books are carried on its shelves.

YOUR OWN 'SWIMMIN' HOLE!'

Anyone who happens to live in a section of the country where streams, lakes, or oceans are unavailable to swim in need not let that worry him. A portable swimming pool has been invented by a man in Baltimore, Md., that brings the "old swimmin' hole" to its owner's back door, to the tourist camp, parks, playgrounds or private estates. It is shaped like the hull of a canal boat with sides and ends made of rubberized fabric. This is supported by means of steel posts and securely attached by waterproof straps. The top of the bag-like natatorium is laced to the bar, which is held in a horizontal position by perpendicular uprights. The large pool in the upper photo is 12x40 feet. It cost $500 to construct.



The smaller pool above was built especially for the kiddies to wade in. Such a pool is safer for this purpose than a natural beach or pool. No guards are needed to watch over the youngsters, and they can enjoy themselves and get just as much benefit as at the sea shore. This pool cost $50. Both pools can be moved anywhere anytime. It is possible to set them up indoors in schools and gymnasiums for use during the winter months.

Edited by RAY F. KUNS

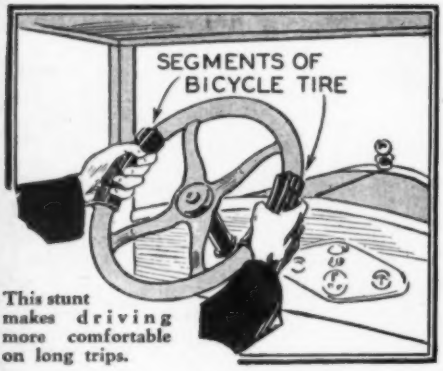
Mr. Kuns, editor of this department, is principal of the Automotive Trade School of Cincinnati, Ohio, and a nationally known expert in his field. He is also editor of the Auto Digest, national auto trade journal. This department of motor hints is a regular monthly feature of Modern Mechanics.

This Month's Timely Tips for Motor Tourists

IF YOU have a new car, break it in for a thousand or two thousand miles before starting on your trip, unless you want to do the breaking in on the way, which requires slower speed for the first three or four days.

A good rule for new cars on tour: 25 miles average for the first day's drive, 30 miles per hour for the second day's drive, 35 miles for the third, 40 for the fourth, 45 for the fifth and beyond that, according to the performance abilities of the car you own.

A newly overhauled car should be treated just as carefully as a new one, if best results are desired.



This stunt makes driving more comfortable on long trips.

Have your car gone over a month before you want to start on the vacation trip, not the day before.

Do not load the car with a lot of needless equipment. You will have a hard time to get 25 miles from a service station in the United States.

Oil, gas, water—carry a little reserve of each. Keep the engine supplied.

Keep the fan belt tight. If overheating is experienced, drain and flush the radiator. Remove any obstructions from the radiator such as license plates, spare tires, etc. Use a hose and wash out the honeycombs or tubes from the inside of the radiator (under the hood) thus driving out dirt, insects, etc., which prevent radiation of heat.

The heavier your load, the more certain the overheating of the motor on long mountain grades. You go to the mountains for the new experience and the scenery. You will have plenty of both. Take time to enjoy the scenery and the new experiences, such as an overheated car, will be less unpleasant. Stop and look while the engine cools.

Do not stop at the top of the hill and pour cold water into the hot engine. It is better to cool the engine gradually, while traveling down the range and then fill the radiator before starting up the next long pull.

Step-by-Step Photos Show Method of Fitting Piston Pins

AFTER removing pistons and connecting rods from the motor, and securing from a supply house the type of piston pins designed for your particular car, the first step in the replacement operation consists of studying the assembly to determine the method of securing the pin. Some pins are clamped in the rod, some are locked in the piston pin boss, and some are floated in both the rod and the piston. The lock screw must be removed completely; then the pin may be drifted out as shown in Figure 1.

The operation of fitting pins is one of reaming. Before reaming, it is, of course,

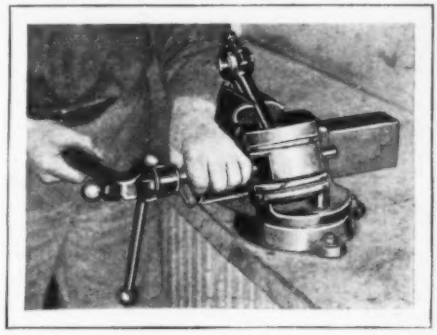


Figure 1—Drifting out the piston pin with a piece of soft steel, piston being clamped in vise.

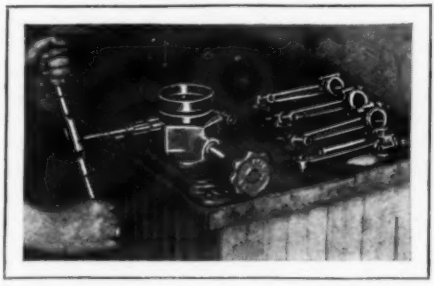


Figure 2—Reaming a piston to fit the piston pin.

necessary to have the new pins. Pins may be purchased, as a rule, in over sizes of .0003, .0005, .0010, .0015. When fitting pins in the Ford Model T piston it is necessary to have the piston pin bushing pressed from the piston and new bushings pressed in. This should be done at the Ford service station, since special equipment is required, which is not usually found in the home workshop.

The reaming operation is shown in Figure 2. The piston is held in a piston vise and the reamer used must be long enough to have a pilot in the second bushing, otherwise the job will not be lined up properly. The reaming is carried to the point where the piston pin may be pushed in to the bushings as shown in Figure 3. This is what is termed a push fit.

If the bushing is in the top end of the rod, the same method is pursued in reaming for a fit. Do not fit the pin so tight that it has to be hammered or forced into the bushing. If the pin is floated in the piston and in the rod bearing, the same fit is used.

Figure 4 shows a method of testing the

Figure 3—The pin should be a "pinch fit."

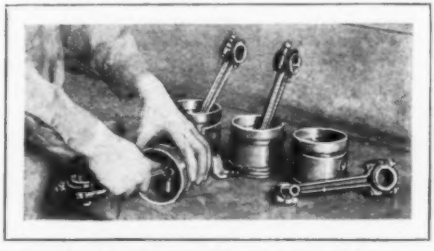


Figure 4—Testing fit of a pin by "side snapping" the rod between the piston pin bosses.

fit of the pin. It should be possible to snap the rod from side to side between the piston pin bosses. Another test is shown in figure 5. When the piston is held as indicated, the weight of the rod should carry it down gently. If a violent jerk is necessary to start the rod falling, the fit is too tight.

The directions given are for pins which are used with a splash system of lubrication. Most pins are splash lubricated. Only those which have an oil line fastened to the connecting rod running to the pin, or those which have an oil hole drilled in their web

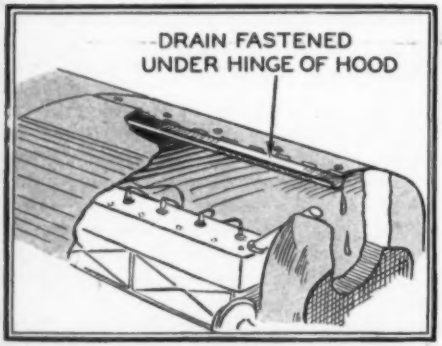
Figure 5—If the piston pin fit is right, the weight of the rod should carry it slowly down when held as shown. If it will not fall, the fit is too tight.

are of the forced lubrication type. In case the pins are lubricated by force feed .001 inch should be allowed for the oil to find its way through.

Water Spout to Protect Wiring

ALMOST every seasoned motorist has had the experience of an engine which is hard to start, or one which will stop, because of water getting in under the hood and setting up short circuits in the wiring. In many cases the hinge joint along the top center line behind the hood is loose and water seeps through to drip down on the wiring or distributor. It is not always necessary for the wires and the distributor to become soaked with water for them to short circuit. If too much moisture is present the spark is likely to be grounded somewhere.

In order to prevent this condition, one motorist has fitted his car with a "spout." The spout is very much on the order of an eave trough, as shown in the drawing below. The spout or trough is made up from sheet metal and shaped half round with a flange for fastening to one side of the hood.



This easily constructed metal drain prevents the motor wiring from being put out of commission when washing the car or driving in rainstorms.

Since the hood always slants to the front of the car, it is well to make certain that this water flowing forward does not strike down on the fan to be thrown on the ignition head. If necessary, place another spout to carry this water away. Any owner having trouble of this nature can correct it himself or have a garage man apply the metal trough.

An Aid to Tire Changing

WHEN a balloon tire is flat, it is very flat, indeed. Not infrequently it is almost impossible to insert the jack. This is especially true on an uneven road-way. The picture illustrated here holds a suggestion for motorists. It is one which has been used to help many a driver out of a bad situation.

Drop a fully inflated tire ahead of the flat one and then drive the car forward onto it. This method saves much heavy work as well as making it possible to insert the jack. It will even lift the axle to such an extent that a log or other support can be inserted beneath it in case there is no jack handy.

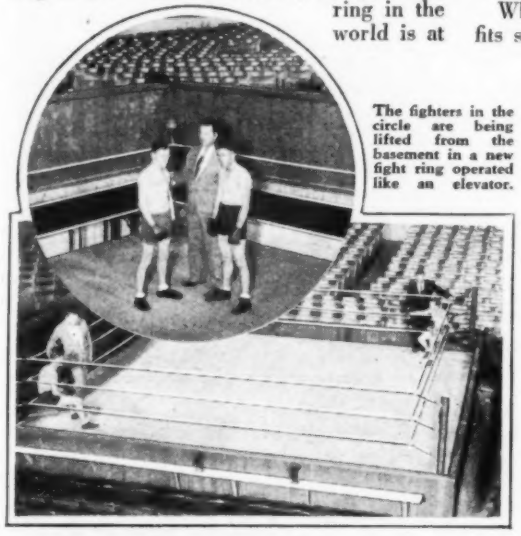
Easy-Fill Radiator Can

FOR a real easy-fill radiator can, take a five-gallon oil container, cut away a large triangle in the corner which bears the screw cap, and in the diagonally opposite corner cut a pouring outlet about two inches across. The large opening serves to admit air to the can and makes for a steady flow. The lip of the pouring outlet should be fashioned into a trough-like shape over an anvil or vise; this will confine the flow to a small diameter and make the radiator-filling operation a quick and cleanly one.

Fight Ring Rises Like Elevator From Floor of Pavilion

JUST as in large theaters, where organs and whole orchestra platforms rise from their pits above the heads of the audience, so will prize rings in the future, according to predictions made. The only disappearing ring in the world is at present in use in the Dreamland Pavilion, San Francisco, Calif. The ring operates like an elevator, rising from the basement before the match with both fighters in their respective corners, dropping again after the fight.

When the ring is "submerged," its top fits smoothly with the rest of the floor.



The fighters in the circle are being lifted from the basement in a new fight ring operated like an elevator.

Claims Rats Will Excel

FOR centuries the rat has been considered the principal villain of the animal kingdom. Men have devoted their lives to the task of destroying this rodent.

But now comes a distinguished British scientist who proclaims that not only is the rat possessed of superior intelligence, highly sharpened senses and an aggressive "life force," but that eventually he may surpass mankind in the earthly scheme of things.

Prof. J. B. S. Haldane, of Cambridge University, is the man who has made this statement. While this view may not be accepted, no one can deny the rat's intelligence.

Mechanical Traffic Officer Suddenly Grows Popular With Youngsters

"TRAFFIC OFFICER TELEVOX," an electric apparatus which directs the movements of cars by the sound of their horns, may be mechanically perfect, but he has no judgment at all! The machine stands at a street intersection in Burlingame, Calif.

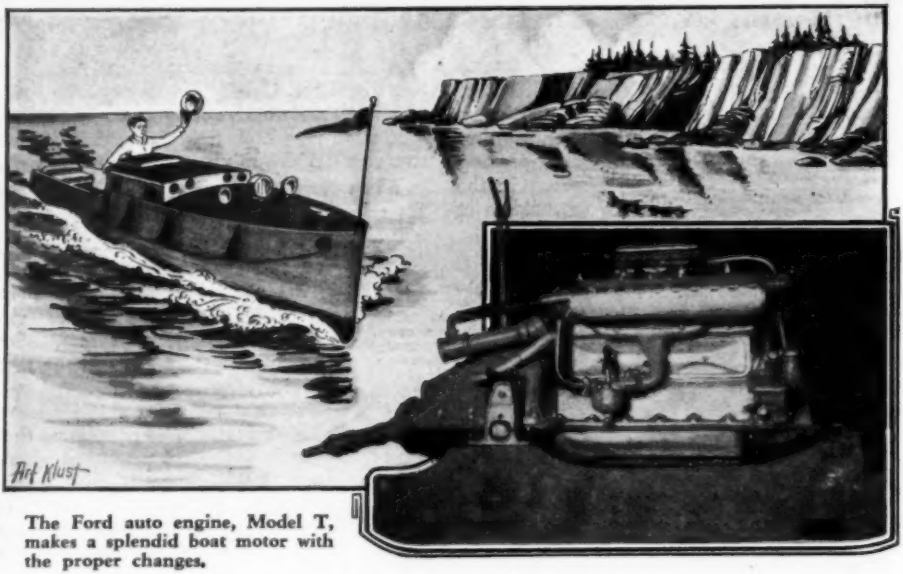
It is not supposed to interrupt the arterial traffic unless a car coming from the cross road wishes to pass and blows its horn to announce the fact. The electric "ear," which causes him to throw his arms in motion and wink his red eye at highway traffic, is very sensitive. Just as the new "policeman" was making a good job of his work, a small boy came along the intersecting street and yelled "ABOoooo" at him. Whereupon, he got rattled, threw his arms about and winked his red eye when he shouldn't have.

Water Telescopes for Fishing

FISHERMEN hunting pearl-bearing oysters look through glass-bottomed boxes at the oyster beds from which they make their selections. Why couldn't trout fishermen employ the same method in angling in clear-watered lakes and rivers?

The frames are open at one end and covered with glass at the other. The glass is submerged below the surface of the water and, unaffected by ripples, the observer is able to see the bottom clearly. He could at least enjoy himself watching the fish refuse the proffered decoy.

Fishermen locate oysters with a water telescope.



The Ford auto engine, Model T, makes a splendid boat motor with the proper changes.

Ford POWERED MOTOR BOATS

By L. W. PEDROSE

CONSERVATION of natural resources by reclaiming waste materials and converting them into useful and valuable products is one of the main problems occupying the attention of science today. Utilization of the waste represented in worn out and obsolete motor cars is such a problem. Annually thousands of automobiles are junked, despite the fact that a large percentage of them contain still useful motors which might be converted to practical needs on farms or in industry where motor power is essential.

Of one particular type of automobile motor alone, the Ford Model T, there were more than 15,000,000 manufactured. At agencies or at wrecking yards there are thousands of these motors which can be purchased for around $3.50 each and can be reconditioned at a cost of $5 to $25 apiece, making it possible to get years of additional service in driving boats, farm and shop machinery and other work where power is required. The conversion is simple, but due to peculiar features of the Ford motor, the same parts, interchangeable with this type of motor, may not convert any other make of motor. The purpose of this article is to show how the Ford motor may be made over at reasonable cost into a remarkably efficient power plant for driving medium-sized boats.

Attempts made by experimenters not familiar with the peculiar construction of the Ford motor to adapt it to new uses have often resulted in failure.

The principal trouble came from burned bearings, resulting from heat thinning out the oil as soon as the engine base became hot.

Ford Motor Drives Boat 30 m.p.h.

Unless properly converted, auto engines usually are not durable enough for boat use. This Ford-powered 16-footer was converted as explained.

Therefore the most important step is cooling this base, across which flows all the lubricating oil circulating in the motor. The Ford motor has no water jacket around the bottom of the cylinders. When the motor is in a car, the base is cooled by air circulation. In converting the motor for marine work a bronze water bottom and pump should be utilized. The water bottom as manufactured by a Seattle firm bolts on to the present bottom pan without additional holes. It forms a chamber for the water to pass through before entering a gear pump. This keeps the bottom of the engine cool at all times and maintains the lubricating oil at full viscosity and quality. A supplementary oil line operating from the magneto plug—a commonly obtainable accessory—supplies a force stream of oil to the front of the motor. These two features are positive insurance against burned bearings.

In this article the conversion of the Ford motor for marine use only is explained. The conversion for other power uses is exactly the same except that a cooling water reservoir is necessary but no thrust bearing or cooled exhaust manifold is required. There are several manufacturers in various parts of the country making conversion parts, should the builder wish to buy them ready to install, and the cost (marine conversion), including water bottom, bronze gear pump, ball-bearing thrust, single lever control and gear change, breather and connections, flanges, brackets and all necessary brass and galvanized piping, is about sixty dollars. For farm or shop use the cost would be about one-half that of the marine conversion. But the builder can make many of these parts himself, if he has the facilities. The writer has assisted in the converting of three Ford motors and their installation in boats—one a heavy work boat, a second a small cruiser, and the third a 20-foot speed boat. All were equipped with starters and generators. The motor in the work boat (a 26-footer) drives it at 9 miles per hour. The cruiser (a 22-footer) has a speed of 12 miles an hour, and the runabout a speed of 18 miles, without reduction gear. Similar size boats have similar speeds. All these power plants were built from reconditioned Ford motors and have operated efficiently

The hull for a boat which can be economically driven by the converted Ford type of marine engine need not cost over $100. Here is a fourteen-foot launch built by Washington high school boys.

Details of the Red Wing conversion parts are shown here. Note the double thrust bearing adapted to the ball housing, and the reverse lever.

and economically and have given as good service as standard marine motors costing three to five times their price. Large numbers of such power plants are in constant use in Pacific and Alaskan waters and have been found to be perfectlv satisfactory.

Before converting the motor, it is assumed that it has been overhauled and put in good working condition, for if it will not work well in a car it will not work in a boat. Following are detailed the necessary steps for changing the regular Ford transmission, and if carefully followed, they will be found simple and easy.

Disassembling the Gears

Remove transmission cover door and loosen bands by unscrewing lock nuts. Remove transmission cover by running out bolts and nuts. Take out all but two bolts in lower crank case. Remove upper case and lift off transmission bands. Compress clutch spring and turn support until clutch spring support pin-hole lines up with pin. Drive out pin and remove spring and clutch shaft. Break wire and run out the six drive-plate cap-screws, then remove drive-plate assembly and push-ring. Take out the 13 large and 12 small transmission discs. Remove cotter pin and run out clutch disc drum set screw. Remove clutch disc drum (a puller may be necessary for this). Drive transmission clutch disc drum-key out of gear-shift and lift out the three driven-gear sleeve washers. Take out brake, slow speed and reverse drums. Remove transmission gear shaft by tapping on end of shaft with brass hammer. Remove driven gear by holding brake drum stationary and withdrawing gear. Remove the two driven gear keys by tapping them out of the keyway.

The water jacketed cooling pan for the oil pump keeps the splash oiling system cool. It fits the ordinary bolt holes in the standard detachable base pan. The cooling water is run into the exhaust line.

To Get Full Speed Back-up

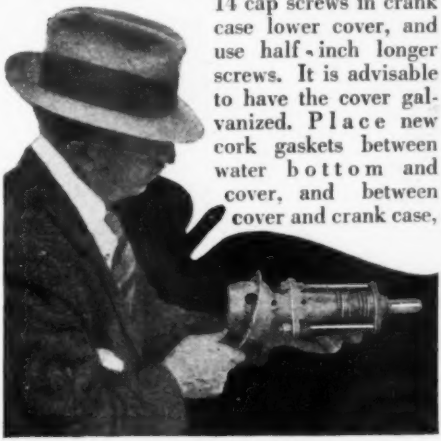
Take driven gear and grind off the teeth, then force it back in place. Leave out the two keys. Slow-speed and brake-drums are to be fastened together by welding or with keys. Slow-speed and brake-drum *bands* are to be discarded. The reverse-drum band *only* is used. The whole transmission is now to be reassembled, but before putting on transmission cover, saw off the re-

verse pedal arm at the bend, which is three inches above the pedal shaft. Discard slow-speed pedal, shaft, spring, washer and nut (it may be easier to saw the shaft than to drift out the pin). Take out and discard brake pedal and shaft. Slow-speed adjustment plug is left in the transmission cover, or a flexible tube may be connected from this opening to the air intake on the carburetor, making it possible to consume all oil fumes given off by motor. Take off brake-pedal support and discard. Leave the bolt in place, but run on the nut so that it will not fall into the transmission before the control bracket is put on. Now replace the transmission cover.

The control bracket, lever and links may be made, or purchased complete for about eight dollars. To install, take the bracket and place the stub shaft in the brake-pedal support hole, inserting bolt at the same time, and tighten securely. Put control lever shaft in the slow-speed pedal hole and slip on the washer, spring and lock washer, and run the nut on to a tension. Connect the lower end of the lever to the clevis that operates the clutch. It may be necessary to make a slight adjustment so that the clutch will release when the lever is in the back-up position. Do this by running the clevis nut in or out a little. You now have neutral position, full speed ahead, and full speed back-up, with ratchet control. Lever to rear is forward speed, and lever forward is reverse speed. The action is smooth and silent.

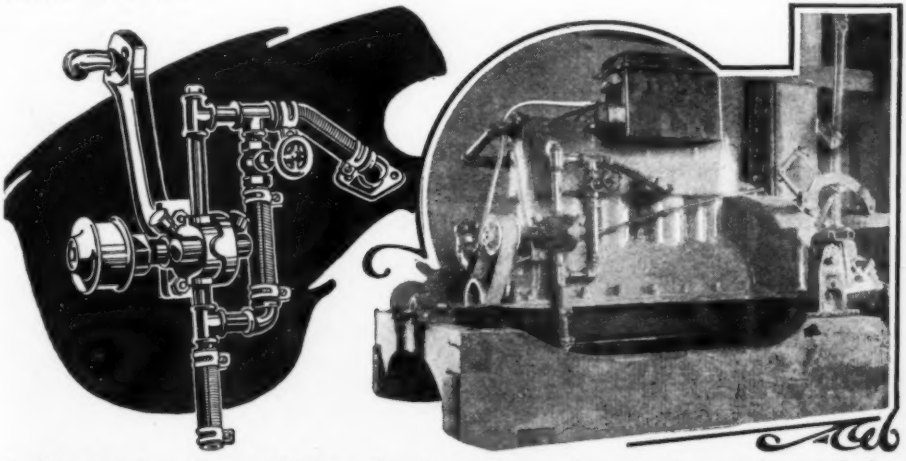
Attaching the Cooling System

To put on the water bottom, run out the 14 cap screws in crank case lower cover, and use half-inch longer screws. It is advisable to have the cover galvanized. Place new cork gaskets between water bottom and cover, and between cover and crank case, and screw back on. Flanges must replace the inlet and outlet water connections. The pump flange goes on the outlet connection. A half-inch bronze gear pump, operated by belt, may be purchased for under ten dollars and is essential equipment. If the conversion parts are bought, piping and pump



Here is a view of the cooling pan for the oil base as manufactured by the Red Wing Co., Seattle, Wash. The intake cooling water runs through this, keeping the oil at right viscosity.

(Continued on page 166)



Run by a belt from the erstwhile fan pulley, the water pump shown in this conversion is valved so that the gear type pump is always primed. The valve is shut when the motor stops and when run again it is opened a minute to prime the pump, then closed again.

Can Almost Smell Odor of These Artificial Tin Flowers

Tin shears and a hammer were used to make these flowers. When painted they look alive.

PUTTING tin roofs on buildings and making artificial flowers aren't usually associated together as a trade. Yet Robert J. Nommo, sheet metal worker in the department of construction of the American Museum of Natural History, can do either.

One day Mr. Nommo saw a flower shop that was displaying a brilliant array of daffodils. During his lunch hour the next day the thought of the pretty flowers came back to him. Taking his shears, he began to fashion some of them from a sheet of tin.

When he had finished them, he took a paint brush and touched them up in their natural colors. Then he showed them to several of his fellow workmen. One of them leaned toward the plants in order to get the odor which he thought was forthcoming.

Trying other flowers, he met with the same success. In each case, as soon as he applied paint, someone always tried to smell the flowers.

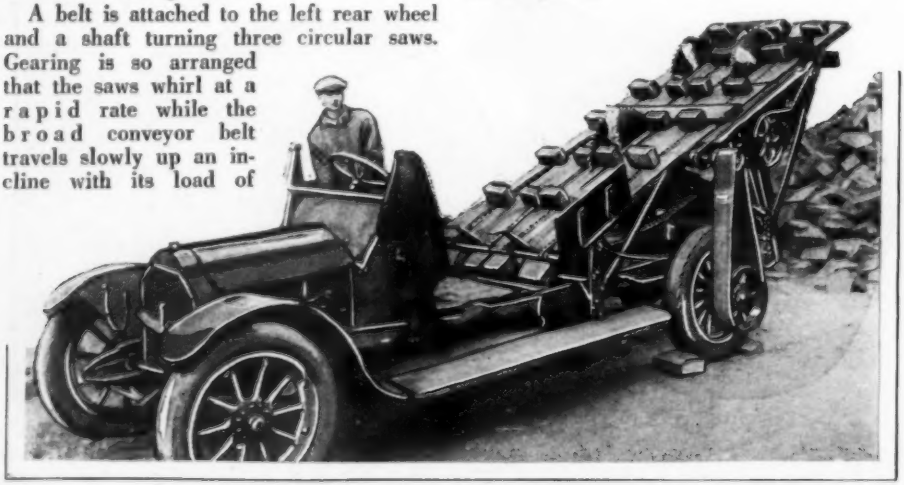
Single Man Operates Home-Made Saw That Does Work of Six Men

DOING the work of six men under the control of one, this sawing machine shown in the photo below has been converted from an ancient automobile that had passed its stage of usefulness on the road.

It was invented by a man in Portland, Oregon, and not only cuts cordwood into the right lengths but also tosses it on a pile or into a waiting truck.

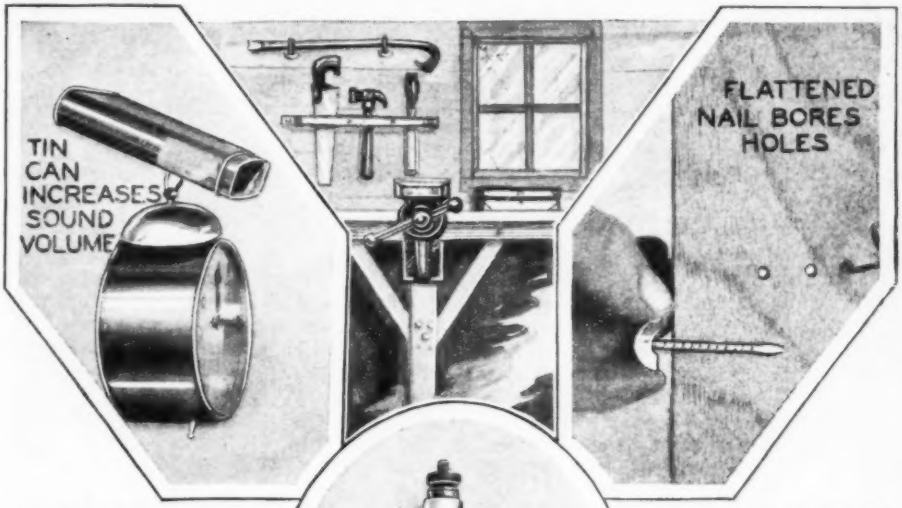
A belt is attached to the left rear wheel and a shaft turning three circular saws. Gearing is so arranged that the saws whirl at a rapid rate while the broad conveyor belt travels slowly up an incline with its load of cordwood lodged on the blocks of the belt.

Each saw does the work of two men. With a single saw it was necessary to handle the wood twice. With this one the operator is kept busy merely placing the cordwood on the belt. The saw does the rest. A truck driven beneath the end of the conveying belt is quickly filled with sawed pieces.



This novel saw cuts a length of cordwood into three pieces, and can be moved about the country.

New Stunts for Shop and Home

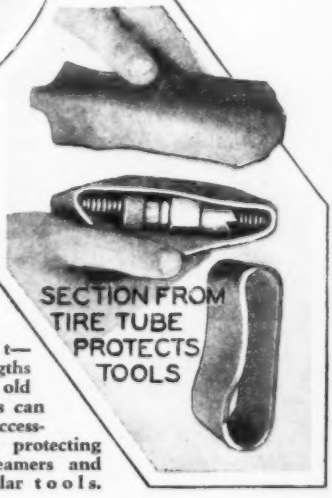


When the alarm clock is placed some distance away from the bed or when its bell becomes too feeble to awaken a sound sleeper, an old tobacco can will strengthen the sound of the alarm considerably if attached as shown above. Rip the cover from the can and cut a slit in flat side.

In cases where it is desired to bore a small hole and no drill is handy, the arrangement shown above will be satisfactory. Take a small nail and flatten out its point, filing the sides to a cutting edge. Flatten the head a trifle, and bend a washer over it as shown above.

Above — Here's a handy stunt for lifting gasoline motors. Attach an L-shaped bit of pipe to a spark plug base and screw into spark plug chamber.

At Left—The top of a tobacco can makes a convenient paddle for filling grease cups, etc., permitting filled cup to be cleaned off.



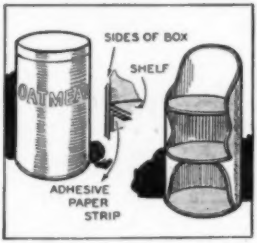
At Right—Short lengths cut from old inner tubes can be used successfully for protecting small reamers and many similar tools.

Items to Interest the Home Mechanic

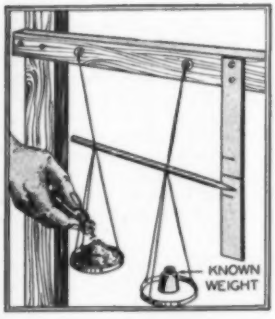
Portable Coathanger Is Handy Device

A PORTABLE coathanger which has several advantages over ordinary nails for hanging up garments in temporary locations is shown at the right. It consists of a wooden panel to which is mounted a metal coat hook. A hole in the top of the wood permits the device to be hung from any convenient nail. Possibility of tearing the clothes, always present when they are hung directly from nails, is thus eliminated. In addition, the bracket will support a coat, overcoat, and hat without taxing its capacity. The hanger can easily be carried in the pocket or in a workman's lunch box.

Novel Corner Shelves Made From Oatmeal Box



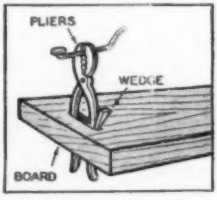
THE familiar round paper containers in which oatmeal and similar cereals are sold can be impressed into useful service as novel corner shelves for the kitchen. Cut away the face of the box as shown in the sketch, or to such shape as fancy may dictate. Next cut two or more circles of stout cardboard to serve as shelves. Glue a strip of cardboard around the inner side of the box for the shelf to rest on, and when this has dried apply a layer of glue to hold the shelves in place.



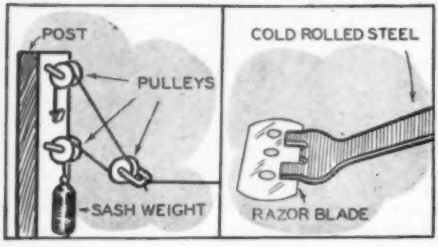
Sensitive Emergency Scale Easily Made

FREQUENTLY the occasion arises when a sensitive scale is required, and the home workshop usually does not boast such an item. A scale which will serve satisfactorily in an emergency can be constructed following the hookup shown in the drawing. A known weight is suspended from one end of a pencil as diagrammed and the position of the pencil tip marked. The item to be weighed is then poured upon the balance until the pencil scale indicates that the required amount is obtained. In measuring chemicals for battery solutions, photographic use, and similar purposes, this device serves the purpose of an expensive scale.

Pliers Make Good Vise for Delicate Work



FOR delicate work such as holding jewelry settings for filing and similar work, ordinary vises exert too much pressure. A pair of pliers, gripping the article to be worked on, can be inserted in a board through which a hole has been bored large enough to accommodate the handles. By tightening the pliers with a wedge as shown, the pressure exerted can be adjusted to any desired degree.



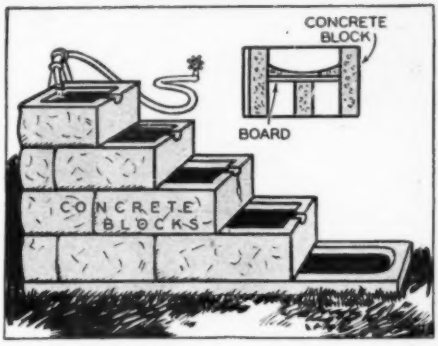
Line Stretcher and Label Remover

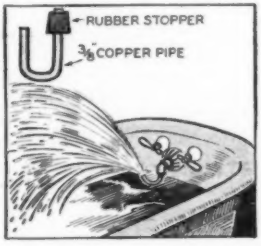
A SASH weight, attached through pulleys to a clothesline as shown in the drawing at the left, will keep the line taut. For removing old labels from fruit jars, procure a piece of cold rolled steel and fix a discarded razor blade into the teeth as shown in the drawing.

For the Gardener and Home Maker

Concrete Block Bird Baths

HALF a dozen concrete blocks, arranged as shown in the diagram, will make a very satisfactory bird bath which is a tasteful addition to any garden. The cross-sectional view shows how a board is inserted flat-wise in the block and covered with a thin coating of cement, forming a shallow trough for the water. A notch is cut into the end of the block to permit the water to overflow through it when it reaches the desired level. Garden hose above the top block furnishes the water supply.



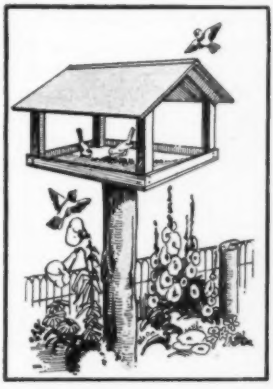


Simple Bathtub Shower Attachment

AN ATTACHMENT which will "cure" leaky bathtub showers, or which will provide a satisfactory shower by itself, is made from a piece of 3/8-inch copper pipe, bent into a gooseneck as shown in the diagram and inserted through a rubber stopper or cork which insures a non-leaking joint at the faucet. If you have an ordinary rubber shower attachment and wish to make a waterproof connection, cut off a section of the tubing and attach it directly to the gooseneck.

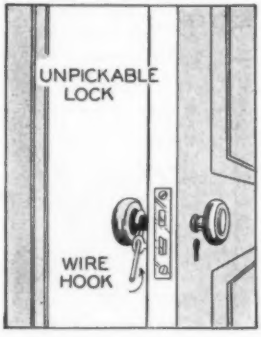
Feeding Shelter Brings Birds Into Garden

BIRDS are attracted by the neat feeding shelter shown in the drawing at the right. It is easily constructed of a few pieces of scrap wood and may conveniently be mounted on a tree stump or on a post especially erected for the purpose. The roof protects the feed table from the weather and birds become accustomed to dropping in at the shelter for a few choice crumbs and bits of suet.



How to Color Brass Vessels

TO IMPART a red color to brass vessels, dip them in a solution of 5 ounces of sulphate of copper mixed with 6 to 7 ounces of permanganate of potash in 500 ounces of water. The results will be found quite attractive.



Wire Hook Makes Door Locks Unpickable

EVER have the experience of having the door lock of your house or hotel room picked by a sneak thief? When locks are not of the Yale variety, it is an easy trick to pick them, but they can be made to resist the efforts of the cleverest lock-picker by the attachment of a simple wire hook as shown in the drawing. An ordinary piece of stiff wire is hooked at one end in the form of a miniature cane. The key is inserted in the lock, the shaft of the wire hook is run through the opening at the finger-grip of the key, and the hook is fitted down over the handle of the door knob.

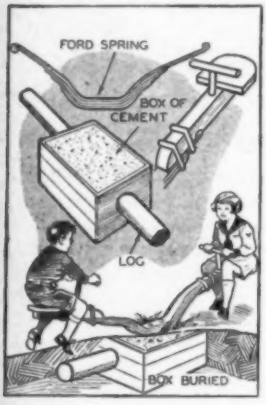
Interesting Stunts for Outdoor Folks

Duck Boat from Sidecar

A SPORTSMAN who wanted an inexpensive duck boat conceived the idea of adapting a motorcycle side car as shown in the drawing at the left. By removing the side car from an old machine and plugging up the bolt holes, he had a light, sturdy boat of one-man capacity of a type easily handled in shallow waters. A little ingenuity in devising a special mounting will enable the boat to be used interchangeably as a sidecar.

Child's Toy from Auto Spring

YOUNGSTERS will find great fun in using the auto spring toy which is shown in the drawing below. All that is required to construct it is a spring from an old Ford car, a little cement, and a few pieces of wood. A hole is dug in the ground to receive a wooden box through which a log shaft has been run. When buried, the projecting ends of the log serve to anchor the teeter-totter. The box is filled with cement, in which the spring is anchored at its center by means of bolts. Wooden seats are then built and attached to the ends of the spring by metal clamps. In burying the box, the earth should be tamped down around it solidly, since the device must be securely anchored to give the resiliency of the spring full play.

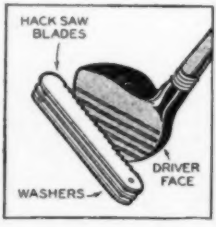


Starting Blocks for Runners

STARTING blocks for track sprinters like those shown in the drawing herewith have recently been patented by G. T. Bresnahan, coach of the University of Iowa track team. The device consists of three pieces of wood, a base piece 10 inches long on top of which is another block which is adjustable by a bolt, regulating the angle of the third piece of wood which is the footrest of the sprinter. The device is anchored to the track at the starting point by long spikes. The purpose of the starting blocks is to do away with holes which trackmen dig into the cinders for toeholds, which frequently are the cause of tripping and falling accidents.

Refacing Golf Clubs

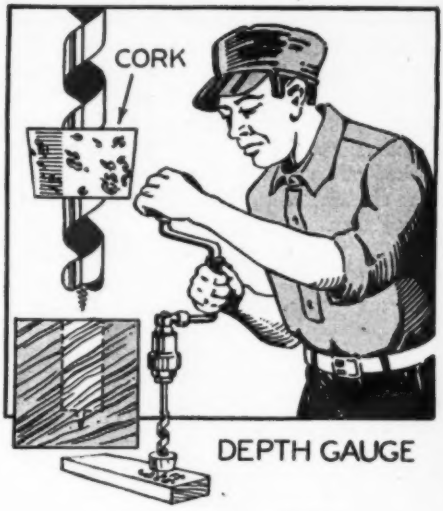
HACKSAW blades can be used to advantage in refacing golf clubs which have become considerably battered through constant use. The drawing below shows how the blades are arranged in repairing the face of a driver. Washers are inserted between the ends of hacksaw blades to spread them apart to the desired distance, and it is then a simple matter to clamp the club in a vise and saw into the club the horizontal grooves which give the golf ball its twirling motion.



Handy Items for the Home Workshop

Cork Makes Good Depth Gauge

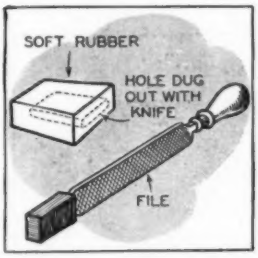
WHEN boring holes into wood and it is not desired that the drill should pass clear through the block, it is sometimes difficult to determine just when the bit has reached the desired depth. A large cork will serve as an efficient depth gauge if the bit is bored through its center as shown in the drawing. The cork moves with the bit, and when it touches the surface of the wood it indicates that the hole has been bored to the required depth.



Cleaning the Tool Cabinet

SOONER or later the drawers of tool cabinets are bound to collect a certain amount of dust. To clean them, use the vacuum cleaner small nozzle attachment, over which is placed a home-made screen constructed from fine wire.

A Safety File Grip

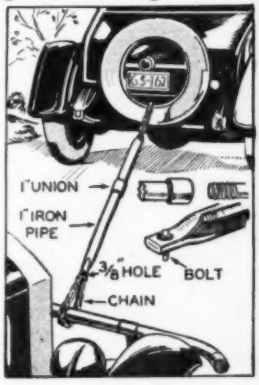


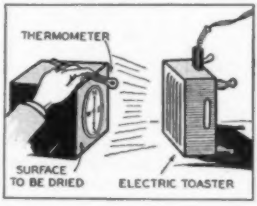
A VERY good little kink for a mechanic who uses a file in the shop a lot, is a small rubber file grip. This grip can be made in a few minutes and protects the worker's hands, as well as giving a better grip on the file, insuring better work.

The grip is made from a piece of soft rubber, 1"x2"x1". In one end a hole is dug out with a knife to enable the file end to slip in rather tightly. For smaller or larger files than the average, several of these grips may be made, as one will not fit all the various sizes to be found in the shop. These grips are easily slipped on and off as required.

Pipe Towing-Rod

WHEN towing disabled automobiles with ordinary rope or metal cable, the two machines sometimes collide when the leading car is forced to stop suddenly and the trailing car is unable to apply its brakes quick enough. If a towing bar similar to the one shown is used, such accidents cannot occur, for the bumpers of the two cars will supply a braking effect when the slack is taken up. This device makes certain that the two cars will at all times remain a uniform distance apart.





Electric Toaster Useful in Drying Paint

AROUND the home workshop an electric toaster is a handy article for speeding paint drying and all sorts of jobs which require slow, steady heat capable of careful regulation. By the use of a thermometer the degree of temperature can be carefully regulated by moving the toaster closer or farther from a newly painted surface until just the right degree for drying is obtained.

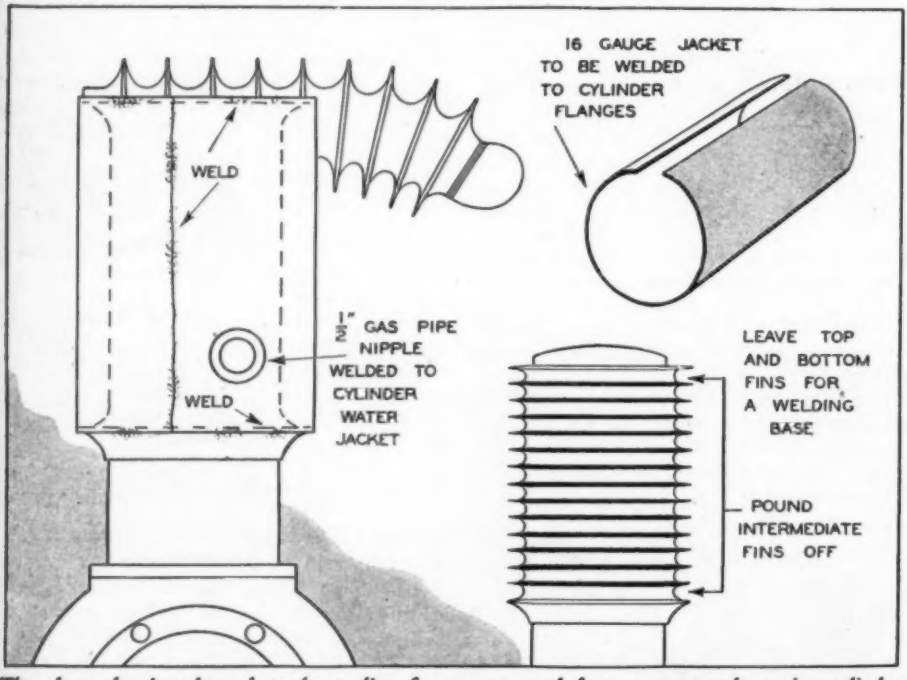
Marine Motor from Motor Cycle Engine

BY REMOVING the cooling fins from a motorcycle engine and fitting the cylinders with water jackets, an efficient marine motor may be built at small expense. The diagram below shows how all of the cooling fins except the top and bottom ones are knocked off to permit a metal jacket of 16 gauge cold rolled steel to be welded around the cylinder.

If you do not wish to risk cracking the cylinder by pounding off the fins, they may be ground down. Just grinding a little off the surface of the fins so that the jacket will fit will not suffice, however, since steam pockets will form which will not permit the water to circulate. The jacket pattern is made by fitting a piece of cardboard over the flanges. If there are difficult curves to fit, wet the cardboard and it will mould easily. Allow about ¼-inch lap. The jacket is welded on in the usual way by first tacking it into position and then flood welding the seams. Cut a hole in top and bottom of the jacket and weld in the water inlet and outlet connections, which are of ½-inch brass pipe.

The cylinders can now easily be cooled by water. If the motor is the twin cylinder vee type (such engines, suitable for adapting to use in a boat, can be purchased cheaply from any repair shop) pipe the water into the two cylinders separately from a tee at the chain driven pump. Use shut-off cocks to prevent the cylinders from draining. To drive the water pump, the regular sprocket of the engine is retained and the rotary pump is driven by a one-to-one chain drive. When the propeller shaft is mounted and the motor installed in a hull of proper size, it will be found to give a very good account of itself.

If you do not wish to go to the trouble of installing a rotary water pump, the regular Ford vane pump can be used which circulates the water by a pulley from the shaft. Either type of cooling system will be found entirely adequate.

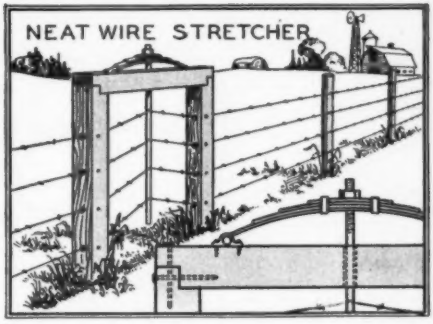

16 GAUGE JACKET TO BE WELDED TO CYLINDER FLANGES
WELD
½" GAS PIPE NIPPLE WELDED TO CYLINDER WATER JACKET
WELD
LEAVE TOP AND BOTTOM FINS FOR A WELDING BASE
POUND INTERMEDIATE FINS OFF

The above drawing shows how the cooling fins are removed from a motorcycle engine cylinder to permit the welding of a water jacket which will convert the engine to a water cooled motor.

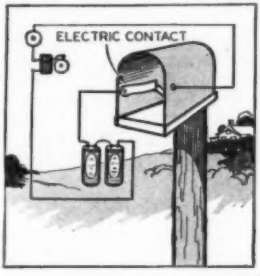
Simple Devices for the Farm Home

Auto Springs Keep Fences Taut

A DISCARDED automobile spring affords an effective means of taking the sag out of wire fences. Two upright posts are topped by a crossbar on the top of which the spring is securely screwed down. A metal bar passes through the crosspiece and is bolted to the center of the spring. The fence wires are attached to this bar when the spring is depressed, and the natural tension when it is released pulls the fence taut, as shown in the drawing to the right.



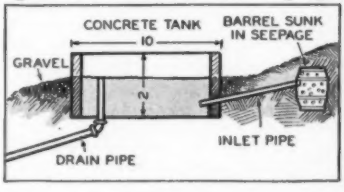
Electric Alarm Tells When Mail Has Come



WHEN the mailbox is some distance away from the house on R. F. D. routes, it will save unnecessary walking to the box to see if the mail has come, if a simple electric alarm is installed, as shown in the diagram at the left. Take two strips of brass and mount one on each inner side of the mail box, insulating it at the point of contact with a piece of fiber. The two brass springs are bent in such fashion that they are always in contact with each other except when mail is thrust into the box, separating them. When the box is empty, the bell in the house will always ring when the button is pressed. When there is mail in the box there will be no contact.

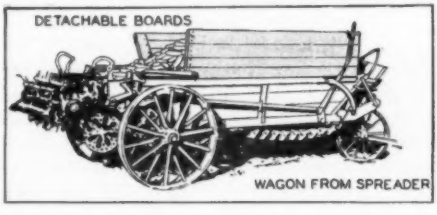
Sunken Barrel Fills Concrete Drinking Trough From Pasture Seepage

IF YOU have a pasture which contains a soggy spot, you can build a good watering trough for the stock after the design shown here. A barrel is punched full of holes, filled with gravel, and sunk in the seepage. A pipe leading from it drains the filtered water into the tank, and an overflow pipe is so arranged that when the water gets above the desired level, it drains off and keeps the water fresh.



Wagon From Spreader

EXPENSIVE spreaders are part of the equipment of every farm and are usually not utilized to as much advantage as they might be. By the addition of detachable boards to the frame, spreaders can be converted into satisfactory wagons for various uses about the farm.



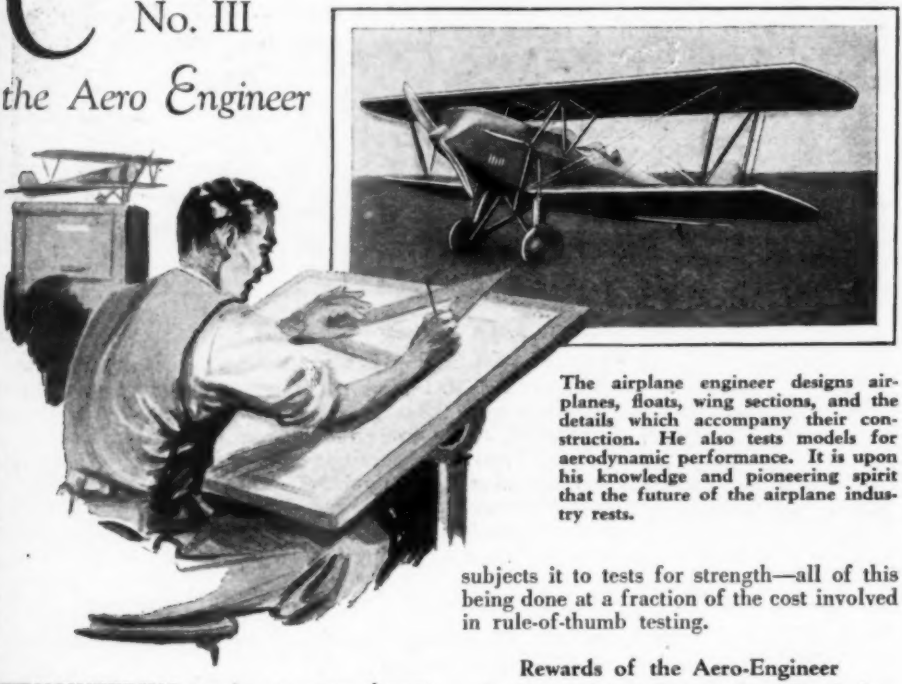
Burning Out Old Stumps

A SUBSTITUTE for backbreaking systems of stump pulling when clearing land is found in the use of fire for destroying the tree stumps. One efficient method which burns out all the underground roots as well as the section exposed above the surface is as follows: Take a two-inch auger and bore a hole down the center of the stump for a distance of a foot or more. Into this opening pour as much kerosene as it will hold. The oil will penetrate to every part of the stump, and if permitted to soak in for a period of two or three months, the wood will be entirely consumed when a match is touched to it.

CHOOSING *Your* JOB

No. III

the Aero Engineer



The airplane engineer designs airplanes, floats, wing sections, and the details which accompany their construction. He also tests models for aerodynamic performance. It is upon his knowledge and pioneering spirit that the future of the airplane industry rests.

ENGINEERING is taken to mean the art of correlating the known facts and laws of mechanics and physics into definitely designed projects and structures.

What an Aero-Engineer Does

The engineer is the man who knows the physical, chemical and mechanical sciences so thoroughly that he can take any of nature's building materials and make what he wants with them, and at the same time knows how strong these structures will be and exactly what may be expected of them.

Naturally, since an engineer can tell beforehand what a given plan will do in the way of performance, he saves manufacturers who employ him a great deal of money every year.

Instead of airplanes having to be tested to destruction so that their strength can be definitely known, which process would be prohibitive in cost, manufacturers say to the engineer, "I want a ship to do thus and so." The engineer, through his knowledge, plans the ship on paper and arithmetically subjects it to tests for strength—all of this being done at a fraction of the cost involved in rule-of-thumb testing.

Rewards of the Aero-Engineer

In this position, that is, the role of planner and cost saver, the engineer who can design ships which will out-perform rivals, cost less to build, which will be safer, and which will therefore build up greater sales for his employer, can virtually name his own salary. In the present turbulent state of infant aviation enthusiasm, salaries are not very high. They range from $2,500 a year on government jobs to $10,000 a year in some cases.

As the industry becomes more settled and competition becomes keener, rich rewards are bound to come to designers of originality who can engineer the planning and construction of new ships which have high performance and safety.

Experiences in This Career

I started my aeronautical engineering career in a practical way. I was educated at Ottawa University and shortly after 1920 became connected with the Loening Engineering Company who are now making the Loening Amphibian. Those were the days,

by Orville H. Hickman

Designer of Air King Commercial planes, the Pheasant, and the Starling.

TO ASSIST Young Americans in choosing profitable careers, Modern Mechanics is presenting a series of authentic vocational articles, of which the Aero Engineer is the third. Advantages as well as disadvantages, the rewards and opportunities, are discussed by men experienced in their field.

Mr. Hickman, shown above, has designed some sixteen successful commercial airplanes, and now at the age of twenty-eight is Vice President of Starling Aircraft Co.

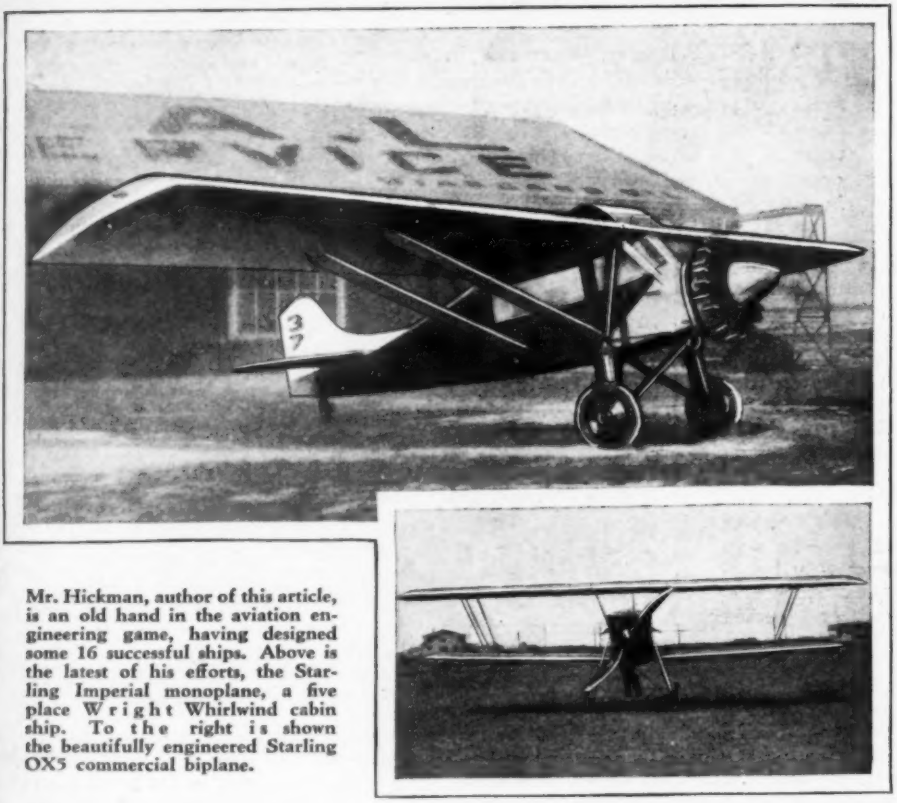
immediately passed, when aviation was at a standstill and jobs were mainly on government work. During this time ante-dating Lindbergh's flight to Paris, the industry was glutted with a surplus of wartime aero engines and supplies, which adequately served the needs of the few flyers who were then making a living barnstorming. Crashes were just frequent enough with this old equipment to put aviation in rather a bad light. Then came the remarkable flights of Byrd, Lindbergh, Chamberlin, and others, proving that modern equipment made aviation eminently safe. About this time war surplus was exhausted and aviation took a new lease of life because of the increased performance made possible by newly engineered ships and this, coupled with a surplus of money in the country, woke up the general public. Today one might say that aviation has just been born. After having worked in an engineering capacity with the Swallow Aircraft Company, National Airways System, Pheasant Aircraft Company, and Starling Aircraft Company, I feel that the future of aeronautical engineering was never so bright. It is a remarkably interesting field for any young man mechanically inclined and will eventually pay higher rewards for men of excellent training than it at present pays.

The Disadvantages of the Profession

In this connection I would caution the reader as to the difference between the man who has a smattering of engineering training and the man who is thoroughly trained. The former generally find plenty of competition in the industry, finding it difficult to get above the routine work of the drawing board. The thoroughly trained man on the other hand, providing he has originality, will one day be able to name his own price and his own working hours.

At present there are disadvantages to the profession. Once a ship is engineered and put into production, most companies today are too small to continue to hire an engineer. Therefore, most engineers today change jobs rather frequently, moving from one project to the next. Within the next three or four years, however, this condition will be changed and competition will have become so keen that large engineering forces will be maintained by every company which hopes to keep abreast of developments.

The best way for a young man to get training is to go to some recognized University where Aeronautical Engineering is taught. This work should not be confused



Mr. Hickman, author of this article, is an old hand in the aviation engineering game, having designed some 16 successful ships. Above is the latest of his efforts, the Starling Imperial monoplane, a five place Wright Whirlwind cabin ship. To the right is shown the beautifully engineered Starling OX5 commercial biplane.

with test flying, the work of the mechanic, or with everyday drafting. It is a work which requires thorough technical training and can be had only in the largest universities. New York University, most State universities, and Boston Tech are examples of the kind of school I mean. This course of training covers in four years such subjects as aerodynamics, mathematics in all phases (which really become more and more interesting as one delves deeper into them), English, languages, and other humanities which go with college life.

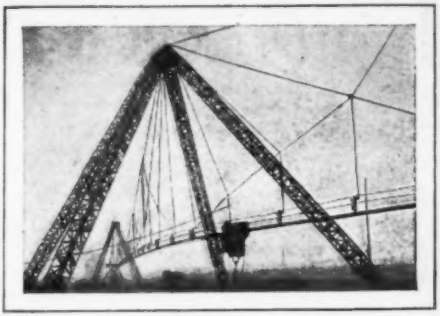
During the course of a student's college career it goes without saying that he should keep abreast of modern developments in the industry. A passive interest should not be taken. He should circulate among flying men at airports and hangars and, if possible, visit as many aircraft factories as he can. By thus circulating he will be well oriented as to what other flyers are looking for in their "ideal ship." It is presupposed that the aviation student who is training himself to be an aeronautical engineer will provide himself with every facility for making himself acquainted with the training given in all branches of aeronautics, such as aviation mechanic, pilot, and so on.

Then with this ground training and presuming the student knows how to fly—he most certainly should be a flyer to get the most out of his course in college—it is then recommended that he join the engineering staff of any recognized, stable, well-financed company. Here he will have the opportunity to see the workings of an engineering department, and after his apprenticeship there he should be able to branch out for himself as a clever designer of reliable aircraft. As such, his successful future would be assured.

Passengers' Luggage Handled Speedily by Monorail Line

HANDLING package freight to and from ocean-going vessels near Hamburg, Germany, is done in an extremely efficient and satisfactory manner. A unique monorail line carries bundles, trunks, etc., over an extensive tract of land and water to the passenger depot.

The cars are drawn by a gasoline motor along a rail suspension line at a rapid rate of speed. By this means, passengers' luggage is quickly transported to and from a ship. Steel ribbed girders support the rail.



This Car Motor Runs Band Saw

OPERATED by a foot clutch, this band saw is attachable to the front of a model T Ford car. It is the invention of a Los Angeles man, shown with the saw at left.

A special coupling connects the shaft of the saw with the drive shaft of the car, furnishing power. The saw is put in motion by the foot clutch, which throws it into gear. By connecting a wire with the carburetor of the automobile, it is possible to regulate the speed of the saw. The conversion is extremely efficient in its operation and requires little time to attach it to the car.

Guard protects the operator's hand from the saw.

Zeppelin Safe for Ocean Flights

THE Zeppelin has greater chances of success than the airplane in trans-oceanic traffic, according to Captain Herrman Koehl, famous German flyer.

"Trans-oceanic flight is sure to come," he said, "but probably in quite a different manner than present opinion expects. Everyone looks for wonders to be performed. I think that nothing miraculous will happen and that progress will come only from intensive and quiet labor.

"The Zeppelin, in my opinion, is today best adapted to distance flights and has the best prospect of application to trans-oceanic flight in coming years. It offers sufficient security for safe air travel over large bodies of water. Through its aid, we can study the principles of the future of airplane travel. Then, after a few years, perhaps planes may supplant the Zeppelin."

Captain Koehl was one of the members of the trans-Atlantic flight of the *Bremen*, German plane which landed at Greenly Island a little more than a year ago.

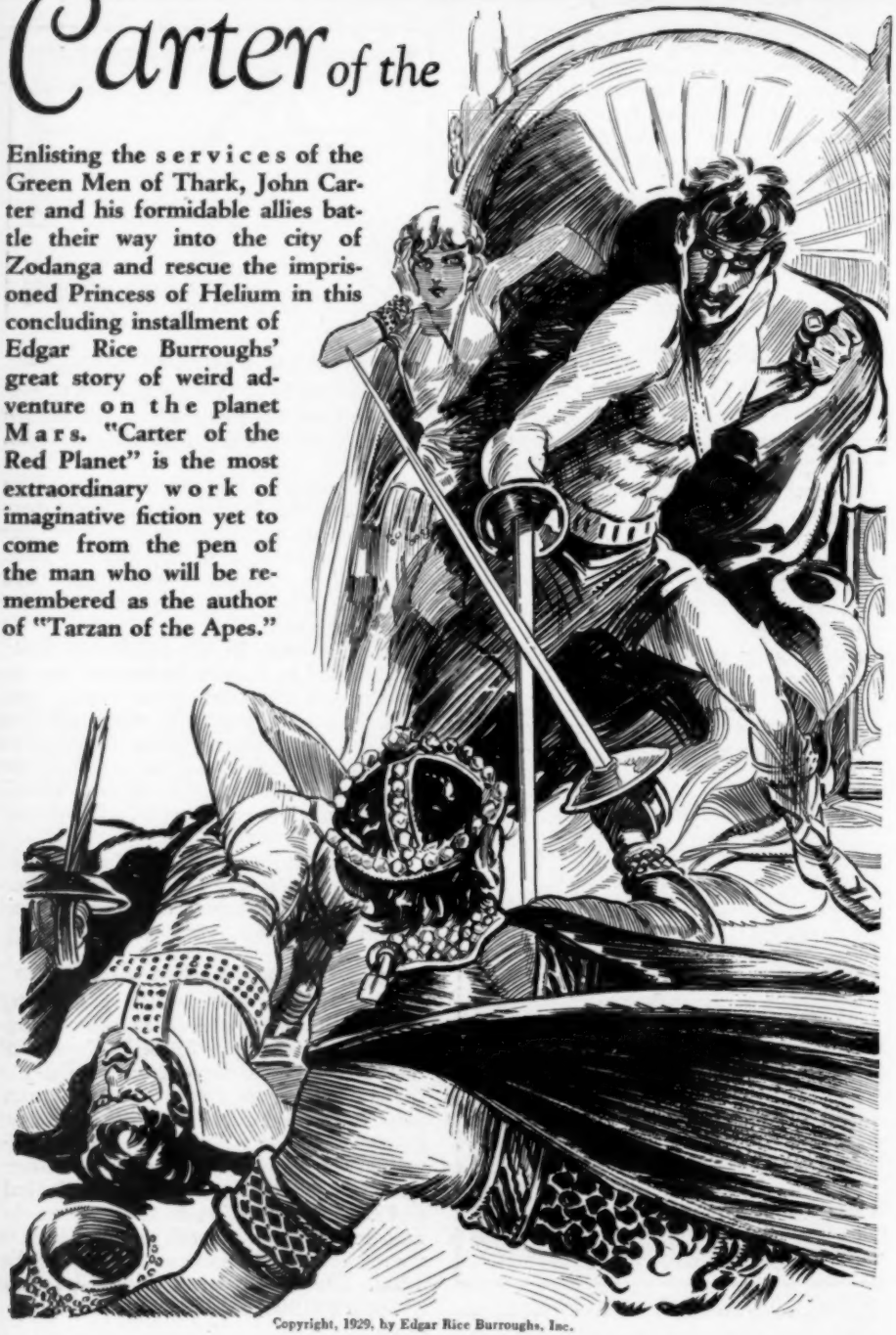
Cope Chicago Crime with Radio

FOLLOWING successful preliminary tests of the use of radio in police operations, Commissioner William F. Russell, of the Chicago Police Department, appealed to the city council for funds to install a complete radio-casting and receiving system for the department.

The plan as outlined includes construction of a transmitting station at the city hall and the purchase of more than 100 special automobiles equipped with receiving sets for use of squads of detectives in outlying districts. The installation is expected to cost between $30,000 and $40,000.

Carter of the

Enlisting the services of the Green Men of Thark, John Carter and his formidable allies battle their way into the city of Zodanga and rescue the imprisoned Princess of Helium in this concluding installment of Edgar Rice Burroughs' great story of weird adventure on the planet Mars. "Carter of the Red Planet" is the most extraordinary work of imaginative fiction yet to come from the pen of the man who will be remembered as the author of "Tarzan of the Apes."



Copyright, 1929, by Edgar Rice Burroughs, Inc.

Red Planet

by EDGAR RICE BURROUGHS
Author of "TARZAN"

IN WHAT strange manner I was transported across the wastes of space to the planet Mars, I cannot say—it was inexplicable to me then, years ago, and it is inexplicable now. The important fact was that I, John Carter of Virginia, awoke to find myself lying on the moss-bound ground of Mars, surrounded by a group of immense four-armed creatures whom I came to know as the Green Men of Mars.

As their captive I was taken to the dead city of Thark, and there I watched an aerial battle between a fleet of mighty ships. From one of these vanquished craft the Green Men captured Dejah Thoris, Princess of Helium—a wonderfully beautiful maiden with whom I at once fell in love.

Desperately determined to escape from our captors, Dejah Thoris and I, accompanied by Sola, Dejah's Tharkian attendant, broke away from the city in the dead of night. We were pursued by the Green Men, but I held off the enemy in a narrow mountain defile while Dejah escaped. Later I was captured and imprisoned, but once again managed to escape and after days of wandering I stumbled upon an immense building which I afterward learned was the atmosphere factory which supplied the air that made it possible for life to exist on Mars.

With Dejah Thoris at my back, I ran the treacherous Sab Than through the chest with my sword. In a moment the room was pandemonium; the Green Men swarmed in and cut their way through the crowd of enraged Zodangans.

I was admitted to the factory by a wizened little man who opened the huge doors with thought waves which I intercepted. Later I discovered that he was aware that I had surmised the secret by which he controlled the gates, and although he remained outwardly friendly, I read suspicion and fear in his mind. He led me to a chamber for the night, and as he departed I saw in his mind a picture of him standing over me, and then the swift thrust of a long dagger and the half formed words, "I am sorry, but it is for the best good of Barsoom."

Escape from the Factory

CAUTIOUSLY I opened the door of my apartment and, followed by Woola, sought the inner of the great doors. A wild scheme had come to me; I would attempt to force the great locks by the nine thought waves I had read in my host's mind.

Creeping stealthily through corridor after corridor and down winding runways which turned hither and thither I finally reached the great hall in which I had broken my long fast that morning. Nowhere had I seen my host, nor did I know where he kept himself by night.

I stole stealthily from my hiding place and crossed to the great door, the inner of the three which stood between me and liberty.

Concentrating my mind upon the massive lock I hurled the nine thought waves against it. In breathless expectancy I waited, when finally the great door moved softly toward me and slid quietly to one side. One after the other the remaining mighty portals opened at my command.

Hastening away from the shadows of the formidable pile I made for the first crossroad, intending to strike the central turnpike as quickly as possible. This I reached about morning and entering the first enclosure I came to I searched for some evidences of a habitation.

There were low rambling buildings of concrete barred with heavy impassable doors, and no amount of hammering and hallooing brought any response. Weary and exhausted from sleeplessness I threw myself upon the ground commanding Woola to stand guard.

Some time later I was awakened by his frightful growlings and opened my eyes to see three red Martians standing a short distance from us and covering me with their rifles.

"I am unarmed and no enemy," I hastened to explain. "I have been a prisoner among the green men and am on my way to Zodanga. All I ask is food and rest for myself and my calot and the proper directions for reaching my destination."

They lowered their rifles and advanced pleasantly toward me placing their right hands upon my left shoulder, after the manner of their custom of salute, and asking me many questions about myself and my wanderings. They then took me to the house of one of them which was only a short distance away.

They were the personification of cordiality and hospitality and I spent several days with them, resting and recuperating from my long and arduous experiences.

When they had heard my story—I omitted all reference to Dejah Thoris and the old man of the atmosphere plant—they advised me to color my body to more nearly resemble their own race and then attempt to find employment in Zodanga, either in the army or the navy.

When I was ready to depart they furnished me with a small domestic bull thoat, such as is used for saddle purposes by all red Martians.

The brothers had supplied me with a reddish oil with which I anointed my entire body and one of them cut my hair, which had grown quite long, in the prevailing fashion of the time.

In the City of Zodanga

WHEN I mentioned my inability to repay them for their kindness to me they assured me that I would have ample opportunity if I lived long upon Barsoom, and bidding me farewell they watched me until I was out of sight upon the broad white turnpike.

Ten days after leaving the three Ptor brothers I arrived at Zodanga. From the moment that I had come in contact with the red inhabitants of Mars I had noticed that Woola drew a great amount of unwelcome attention to me, since the huge brute belonged to a species which is never domesticated by the red men. I could not permit even Woola's life to threaten the success of my venture, much less his momentary happiness, for I doubted not he soon would forget me. And so I bade the poor beast an affectionate farewell, promising him, however, that if I came through my adventure in safety that in some way I should find the

means to search him out.

The letter I bore from them gained me immediate entrance to the vast, walled city. It was still very early in the morning and the streets were practically deserted. The residences, raised high upon their metal columns, resembled huge rookeries, while the uprights themselves presented the appearance of steel tree trunks.

The Ptor brothers had given me explicit directions for reaching the point of the city where I could find living accommodations and be near the offices of the government agents to whom they had given me letters. My way led to the central square or plaza, which is a characteristic of all Martian cities.

The flagship of the air battle fleet of the Zodangans went down in flames, shattered by a salvo from our guns. In a moment several smaller ships flamed to earth—we had won!

As I was crossing the great square lost in wonder and admiration of the magnificent architecture and the gorgeous scarlet vegetation which carpeted the broad lawns I discovered a red Martian walking briskly toward me from one of the avenues. He paid not the slightest attention to me, but as he came abreast I recognized him, and turning I placed my hand upon his shoulder, calling out:

"Kaor, Kantos Kan!"

Like lightning he wheeled and before I could so much as lower my hand the point of his longsword was at my breast.

"Who are you?" he growled, and then as a backward leap carried me fifty feet from his sword he dropped the point to the ground and exclaimed, laughing,

"I do not need a better reply; there is but one man upon all Barsoom who can bounce about like a rubber ball.

"You gave me a bad half minute, my friend," he continued, after I had briefly outlined my adventures since parting with him in the arena at Warhoon. "Were my name and city known to the Zodangans I would shortly be sitting on the banks of the lost sea of Korus with my revered and departed ancestors. I am here in the interests of Tardos Mors, Jeddak of Helium, to discover the whereabouts of Dejah Thoris, our princess. Sab Than, prince of Zodanga, has her hidden in the city and has fallen in love with her. His father, Than Kosis, Jeddak of Zodanga, has made her voluntary marriage to his son the price of peace between our countries.

Member of the Air Fleet

"I HAVE been here three days," continued Kantos Kan, "but I have not yet found where Dejah Thoris is imprisoned. Today I join the Zodangan navy as an air scout and I hope in this way to win the confidence of Sab Than, the prince, who is commander of this division of the navy, and thus learn the whereabouts of Dejah Thoris."

The plaza was now commencing to fill with people going and coming upon the daily activities of their duties. The shops were opening and the cafes filling with early morning patrons. Kantos Kan led me to one of these gorgeous eating places where we were served entirely by mechanical apparatus.

After our meal, Kantos Kan took me with him to the headquarters of the air-scout squadron and introducing me to his super-

ior asked that I be enrolled as a member of the corps. In accordance with custom an examination was necessary, but Kantos Kan had told me to have no fear on this score as he would attend to that part of the matter. He accomplished this by taking my order for examination to the examining officer and representing himself as John Carter.

The next few days were spent by Kantos Kan in teaching me the intricacies of flying and of repairing the dainty little contrivances which the Martians use for this purpose. The body of the one-man air craft is about sixteen feet long, two feet wide and three inches thick, tapering to a point at each end. The driver sits on top of this plane upon a seat constructed over the small, noiseless radium engine which propels it.

Battle in the Air

THE fourth day after my arrival at Zodanga I made my first flight, and as a result of it I won a promotion which included quarters in the palace of Than Kosis.

As I rose above the city I circled several times, as I had seen Kantos Kan do, and then throwing my engine into top speed I raced at terrific velocity toward the south, following one of the great waterways which enter Zodanga from that direction.

I had traversed perhaps two hundred miles in a little less than an hour when I descried far below me a party of three green warriors racing madly toward a small figure on foot which seemed to be trying to reach the confines of one of the walled fields.

Dropping my machine rapidly toward them, and circling to the rear of the warriors, I soon saw that the object of their pursuit was a red Martian wearing the metal of the scout squadron to which I was attached. A short distance away lay his tiny flier, surrounded by the tools with which he had evidently been occupied in repairing some damage when surprised by the green warriors.

Driving my fleet air craft at high speed directly behind the warriors I soon overtook them and without diminishing my speed I rammed the prow of my little flier between the shoulders of the nearest. The impact, sufficient to have torn through inches of solid steel, hurled the fellow's headless body into the air over the head of his thoat, where it fell sprawling upon the moss. The mounts of the other two warriors turned squealing in terror, and bolted in opposite directions.

Reducing my speed I circled and came to the ground at the feet of the astonished Zodangan. We wasted no time in talk as we knew that the warriors would surely return as soon as they had gained control of their mounts.

Quickly completing the repairs we rose together into the still, cloudless Martian sky, and at great speed and without further mishap returned to Zodanga.

As we neared the city we discovered a mighty concourse of civilians and troops assembled upon the plain before the city. The sky was black with naval vessels and private and public pleasure craft, flying long streamers of gay-colored silks, and banners and flags of odd and picturesque design.

My companion signaled that I slow down, and running his machine close beside mine suggested that we approach and watch the ceremony, which, he said, was for the purpose of conferring honors on individual officers and men for bravery and other distinguished service. He then unfurled a little ensign which denoted that his craft bore a member of the royal family of Zodanga, and together we made our way through the maze of low-lying air vessels until we hung directly over the jeddak of Zodanga and his staff.

One of the staff called the attention of Than Kosis to the presence of my companion above them and the ruler motioned for him to descend. As they waited for the troops to move into position facing the jeddak the two talked earnestly together, the jeddak and his staff occasionally glancing up at me. A member of the staff advanced toward the troops, and calling the name of a soldier commanded him to advance. Ten men had been decorated when the aid called out,

"John Carter, air scout!"

In the Service of the Jeddak

NEVER in my life had I been so surprised, but the habit of military discipline is strong within me, and I dropped my little machine lightly to the ground and advanced on foot as I had seen the others do. Than Kosis then advanced toward me and placing an ornament upon me, said:

"My cousin has narrated the details of your wonderful achievement, which seems little short of miraculous, and if you can so well defend a cousin of the jeddak how much better could you defend the person of the jeddak himself. You are therefore appointed a padwar of The Guards and will be quartered in my palace hereafter."

I thanked him, and at his direction joined the members of his staff. After the ceremony I returned my machine to its quarters on the roof of the barracks of the air-scout squadron, and with an orderly from the palace to guide me I reported to the officer in charge of the palace.

The major-domo to whom I reported had been given instructions to station me near the person of the jeddak, who, in time of war, is always in great danger of assassination.

He therefore escorted me immediately to the apartment in which Than Kosis then was. The ruler was engaged in conversation with his son, Sab Than, and several courtiers of his household, and did not perceive my entrance.

The walls of the apartment were completely hung with splendid tapestries which hid any windows or doors which may have pierced them. My guide drew aside one of the tapestries, disclosing a passage which encircled the room, between the hangings and the walls of the chamber. Within this passage I was to remain, he said, so long as Than Kosis was in the apartment. When he left I was to follow.

The tapestries were of a strange weaving which gave the appearance of heavy solidity from one side, but from my hiding place I could perceive all that took place within the room as readily as though there had been no curtain intervening.

Scarcely had I gained my post than the tapestry at the opposite end of the chamber separated and four soldiers of The Guard entered, surrounding a female figure. As they approached Than Kosis the soldiers fell to either side and there standing before the jeddak and not ten feet from me, her beautiful face radiant with smiles, was Dejah Thoris.

Sab Than, Prince of Zodanga, advanced to meet her, and hand in hand they approached close to the jeddak. Than Kosis looked up in surprise, and, rising, saluted her.

"To what strange freak do I owe this visit from the Princess of Helium, who, two days ago, with rare consideration for my pride, assured me that she would prefer Tal Hajus, the green Thark, to my son?"

Dejah Thoris only smiled the more and with the roguish dimples playing at the corners of her mouth she made answer:

"From the beginning of time upon Barsoom it has been the prerogative of woman to change her mind as she listed and to dissemble in matters concerning her heart. That you will forgive, Than Kosis, as has your son. Two days ago I was not sure of his love for me, but now I am, and I have come to beg of you to forget my rash words and to accept the assurance of the Princess of Helium that when the time comes she will wed Sab Than, Prince of Zodanga."

I Seek the Princess

THUS was the edifice of my brief dream of happiness dashed, broken, to the ground of reality. The woman for whom I had offered my life, and from whose lips I had so recently heard a declaration of love for me, had lightly forgotten my very existence and smilingly given herself to the son of her people's most hated enemy.

Although I had heard it with my own ears I could not believe it. I must search out her apartments and force her to repeat the cruel truth to me alone before I would be convinced, and so I deserted my post and hastened through the passage behind the tapestries toward the door by which she had left the chamber. Slipping quietly through this opening I discovered a maze of winding corridors, branching and turning in every direction.

Moving on a few steps I discovered a passage-way at the end of which lay a door. Walking boldly forward I pushed into the room only to find myself in a small ante chamber in which were the four guards who had accompanied her. One of them instantly arose and accosted me, asking the nature of my business.

"I am from Than Kosis," I replied, "and wish to speak privately with Dejah Thoris, Princess of Helium."

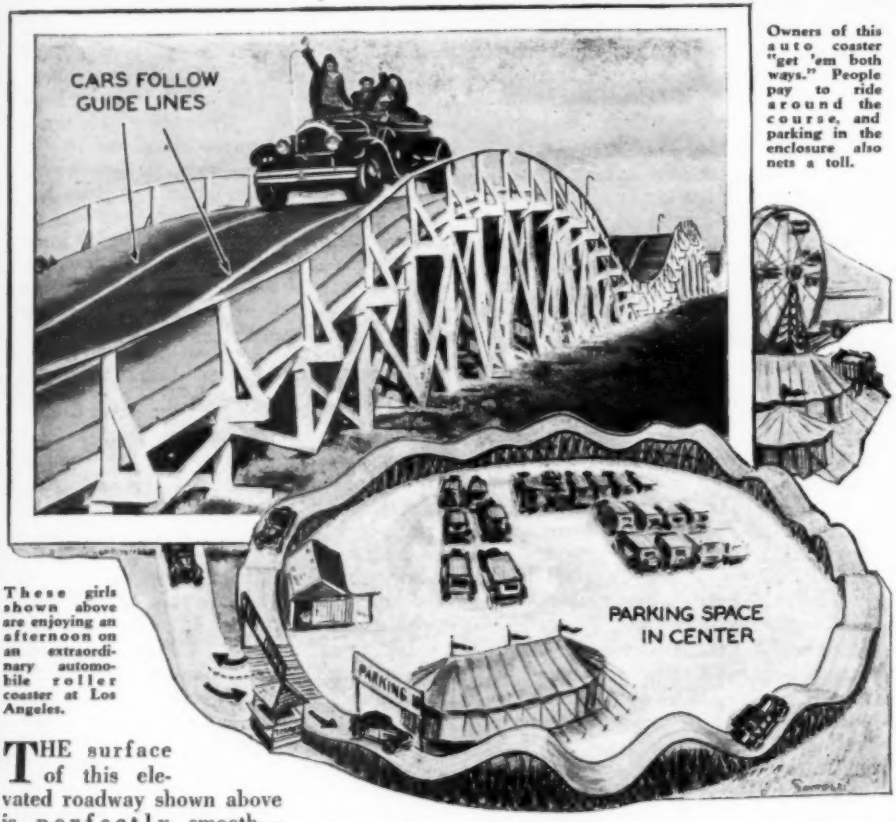
"And your order?" asked the fellow.

I did not know what he meant, but replied that I was a member of The Guard, and without waiting for a reply from him I strode toward the opposite door of the ante chamber.

But my entrance was not to be so easily accomplished. The guardsman stepped be-

(Continued on page 173)

Thrills of Driving Own Car on Auto Roller Coaster



Owners of this auto coaster "get 'em both ways." People pay to ride around the course, and parking in the enclosure also nets a toll.

These girls shown above are enjoying an afternoon on an extraordinary automobile roller coaster at Los Angeles.

THE surface of this elevated roadway shown above is perfectly smooth—smooth, but not level. A succession of dips and rises that range in depth from five to ten feet afford motorists, running their cars over the course, all the thrills and pleasures of a roller coaster.

Recently opened in Los Angeles, the new "road" is operated in conjunction with an amusement park. People drive their cars into the entrance, purchase a ticket that entitles them to ride once around the "wavy road" and begin their journey.

The road is constructed entirely of wood. Its circumference measures 2,243 feet, and a railing protects cars from skidding off the edges.

It is wide enough to allow two cars to pass easily, but only one-way traffic is permitted. Drivers are instructed to follow the white guide lines painted on the surface of the roadway.

Regulations are also placed on the speed at which a car may be driven over the coaster. Although the curves are banked to make it practically impossible to turn over when rounding them at a fast rate of speed, the dips and rises will throw a car out of control if driven too fast.

Real Kick in Bootleg Liquor — Chemist Finds T. N. T. in Samples

"THE worst ever seen in the department!" That's what Hermann C. Lythgoe, Massachusetts state chemist, said after analysis of 1,975 samples of liquor captured from bootleggers. More than five per cent contained wood alcohol, while others ranged from kerosene bases to touline, from which T.N.T. is made.

Air Fighter Maintains 190 M.P.H. in High Altitudes

ONE hundred and ninety miles an hour with two machine guns spitting a deadly stream of bullets into an enemy plane is the performance capable of the new Westland Wizard monoplane, recently adopted by the British government for use in time of war.

The plane is powered by a single Rolls-Royce engine and maintains its speed in rarefied atmosphere, found two or more miles above the earth.

It is armed with two machine guns and a load of light bombs. These are dropped through a special opening in the bottom of the fuselage.

The tremendous speed of the ship gives it a decided advantage over slower fighters.

Test Navy Dirigible's Girders

DURALUMIN metal comprises the girders of the new Navy dirigible being built by the Goodyear-Zeppelin Corporation at Akron, Ohio. Tests of the strength of the girders are being made as shown in the photo at the right. Samples were placed in an extremely powerful hydraulic press.

These girders are being used as the main framework of the dirigible and were tested under straight axial and under combined axial and transverse loads.

The axial load was applied by an Emory testing machine capable of exerting 2,300,000 pounds compression. To experiment with the transverse load, dead weight was used.

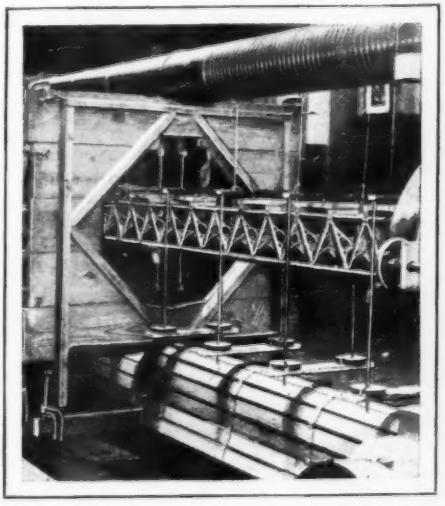
The tests were conducted in the laboratories of the Bureau of Standards, Washington, D. C., under the supervision of Dr. L. B. Tuckerman.

600 Yards of Silk Lowers Plane

WITH its motor cut off at an altitude of 5,000 feet, an airplane was successfully lowered to the ground by a parachute at Santa Ana, Calif., recently. The chute was released from the plane by a coil spring and took up the ship's weight of 2,800 pounds after a drop of 200 feet.

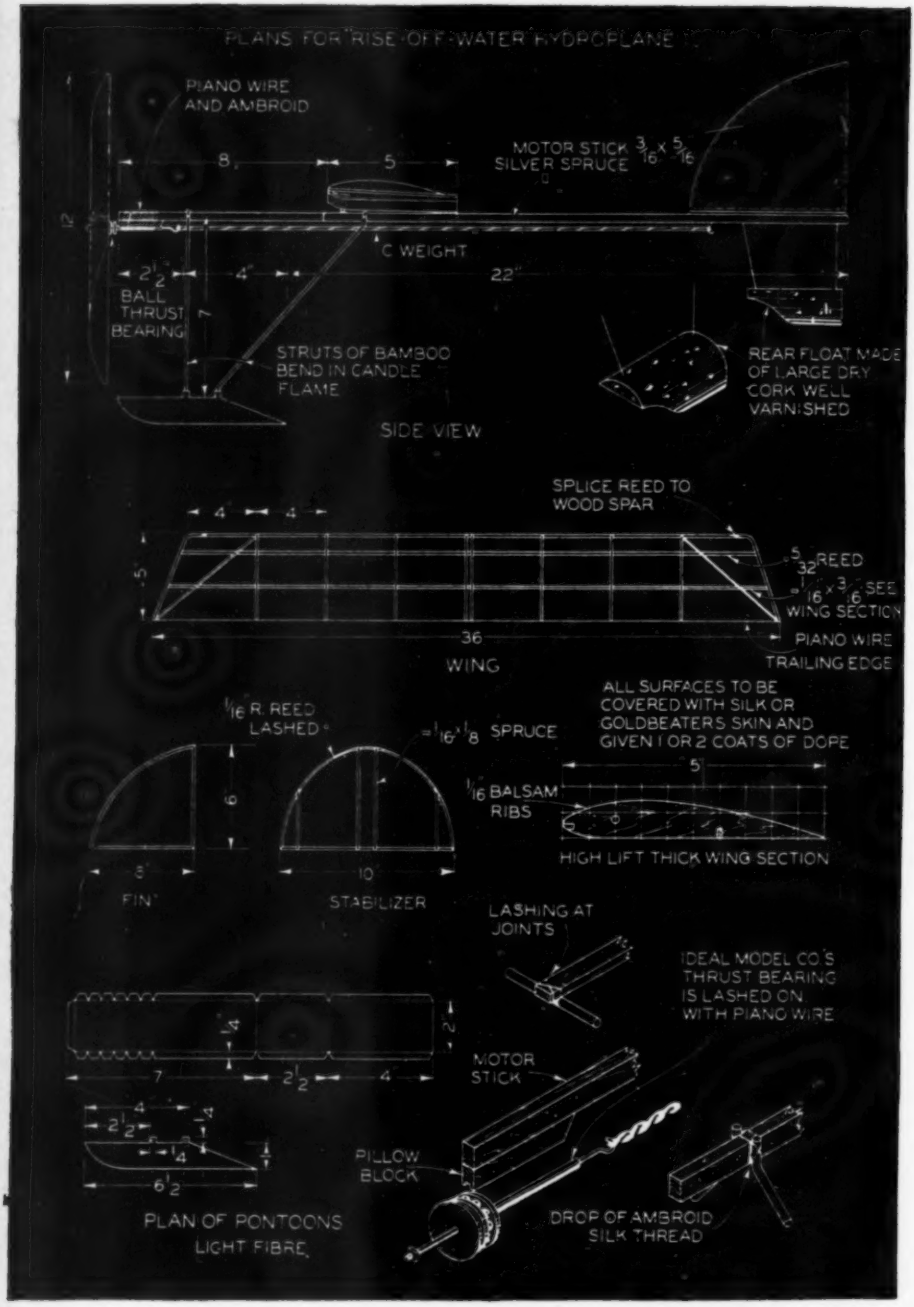
Captain Roscoe Turner piloted the craft, which was a biplane. It landed gently in a field three miles from the Martin airport, where it had taken off. The parachute was 60 feet in diameter.

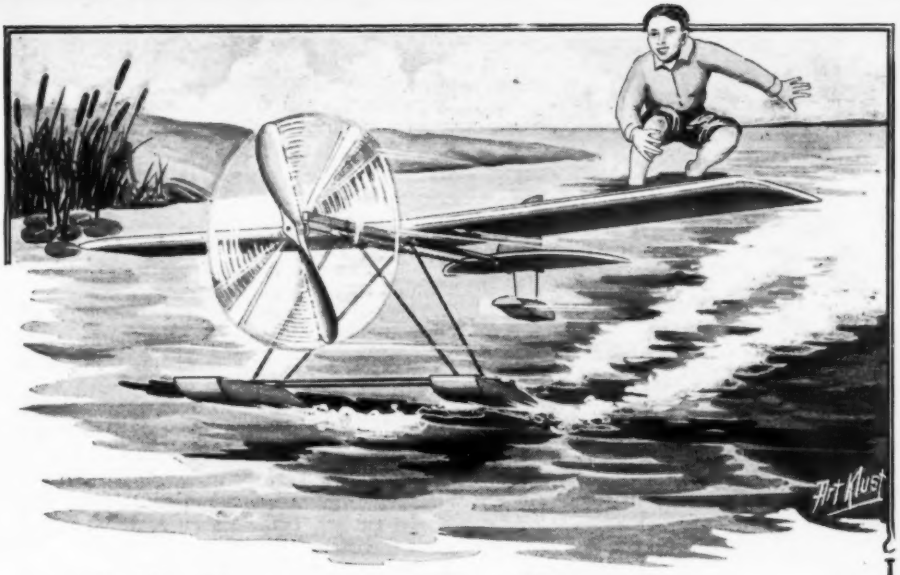
The experiment illustrates another step in advance of safety in air travel.



The apparatus shown above applies tremendous pressure and weight on a dirigible girder.

Parts Blueprint of Model Seaplane Which Rises Under Its Own Power





A "Rise-Off-Water" MODEL HYDROPLANE

By GILBERT MICKELSON

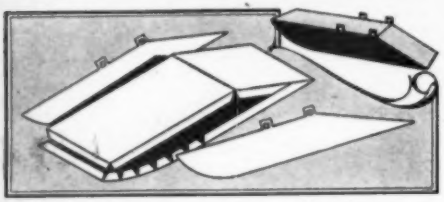
THIS model of a rise-off-water airplane was kindly supplied the writer by James Pitcairn, who lives in Milwaukee and who has made a number of flights with it. It is a good model and if strongly constructed will rise without trouble from the surface of a calm lake and will fly for about 100 feet. So much of the power of the rubber motor is used in getting the model off the water that there is not a great deal left for it to fly on.

The motor stick is of the usual type. Were a fuselage used instead of the stick, the model would be too heavy to get off the water. The stick is 28 inches long and has the hook fastened in the usual way. The way the motor mounting for the front thrust bearing is mounted is shown in the blueprint. A piece the same size as the motor stick is cut off, beveled, hollowed, and the bearing is lashed with it by fine piano wire. Use just enough piano wire to do the trick. If you use too much, unnecessary weight will be added and the model will be just that much harder to fly.

Ambroid glue should be used in this mounting. It is best to put on a thin coat of the glue, and let it get tacky or almost dry, and then put on all the glue and let it set well. Ambroid is a glue with a banana oil base which dries very quickly. It is pleasant to smell and will prove very strong.

With the motor stick made, the next thing to do is to carve out the propeller. This can be purchased from the Ideal Aeroplane Supply Company, New York City, and can be had in a finished condition or in a blank form. The blank is carved out with the aid of a jackknife and the bulby side of the blade, bear in mind, is the side which wants to bite the air first. The cutting is done a little bit at a time rather than taking big cuts, and running the danger of splitting the blank. Finish with coarse sandpaper, and then with a light sandpaper.

Single Floats Are Made of Fiber



The method of building the fiber floats is depicted here. Use ambroid for glue.

Put a coat of white shellac on the propeller and when this is dry you can sand it lightly. Do not overload anything that goes into the model with more covering finishes like paints and so on than the thing really needs. Weight must be saved if the model is to fly well.

The propeller can be mounted to the bearing with the usual little screws and the motor stick is completed.

Then come the wings. These are of the section shown in the drawing, which have a chord of 5 inches. There are 9 ribs 4 inches apart, and they are made all to the same template, as the drawing shows, just like large airfoils. The leading edge is a piece of flat spruce laid edgeways to give strength, the main spar is a thick piece of reed, and the rear spar is laid the proper way to do the right thing in giving the rear of the wing good strength. Note the piano wire trailing edge and the balsa wood strengthening ribs on the ends of the wing. The wing is assembled as follows: Start at one end and fasten one rib completely, using ambroid. Then put the next one on, and progress toward the front of the wing. That is, work one direction only. Don't skip around. When the frame work is dry you are ready to cover the surface with fine silk, or with goldbeaters skin, which can be purchased at the model supply houses. This should be doped with one or two coats of very thin dope, which will give it a lot of strength, and make it tight and rigid.

The stabilizer and the fin are made up to the dimensions shown and are merely flat plates. They are covered and treated in the same way the wings are made.

With the wings done and the motor done, what you need next to finish are the floats and the struts which hold them in place.

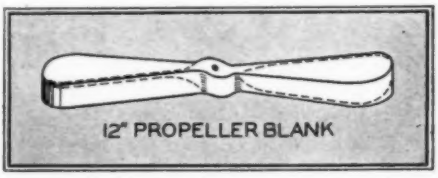
Get some light fiber, the lightest that is sold by the airplane model supply houses, and make two floats to the pattern shown in the drawing. Score the lines you are going to fold the float on with a scratch awl. Then the fiber will bend where you want it to without cracking. Cut the tabs so that where the hull turns up on the bottom you will have no trouble bending it to shape. Take the two sides you have made and glue the floats up with ambroid. Then set them away to dry for an hour or so.

Then they can be shellacked. Then they are dry and ready for the water.

The lashings used for the surfaces are of silk, and when tightly wound they are secured with a drop of ambroid, which will shrink the thread when it dries.

The wing is put on in the same way, and the ship is now complete except for the rubber motor, which will have to be wound on a skein to size.

This consists of about thirty to forty feet of flat rubber, and goes on as thick as the stick will stand to have it when wound. The rubber will come so flat that it will be troublesome. It should be made into a skein, large enough for slipping off the pegs and putting right on the motor. Never oil the rubber, it will rot it in a week. The



The propeller blank is carved so that the leading edge is on the round or "bulby" side.

motor can be wound by hand or with an improvised crank made from an egg beater.

To fly the model, select a day which is calm. Wind the motor up no more than a hundred revolutions at first, backwards of course, so that when it unwinds it will have a forward motion. Try the model for balance, and adjust the trim to a fine hair. Then wind the motor a hundred and fifty turns. The model should get into the air. By practice you will be able to know just how much to wind the motor to give the model a good performance. The original of this model has flown for better than 150 feet on a calm day, facing a light zephyr.

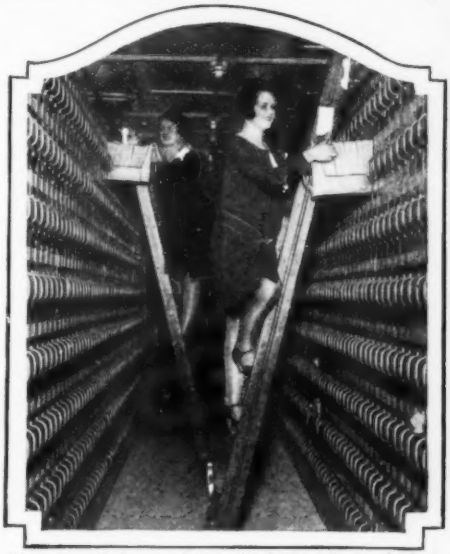
The model should be taken from the water and kept out of it as much as possible, because they soak up water fast, and this raises trouble in flying.

New Type of Filing Cabinet Affords Speed and Accuracy

THESE girls, shown at right, don't have to worry about taking reducing exercises. They are filing clerks in the office of the New York Life Insurance company, New York, and spend their working day climbing and moving the ladders shown.

Eight rows of files in huge cabinets hold millions of dollars worth of policies. The drawers slide in and out easily on roller bearings, facilitating the time required to file a document.

Rollers are placed on the feet of the ladders and are operated by a lever on their side. A pull of this draws the rollers up so that the ladder will stand perfectly stationary.



Drawers of these cabinets locked with single key.

Device Aids Voice for "Talkies"

NOW that "talkies" are eclipsing the old silent moving pictures, requisites of a film star include articulation and pronunciation of the voice. Richard Arlen, Paramount player, is shown at left using an apparatus that allows him to listen to his tone and emphasis while practising some new lines for a picture he is making.

As he talks into the megaphone, his voice is recorded on a wax disc that can be played immediately afterward.

This allows him to get the exact effect of his voice as it will sound to an audience. The device is attachable to any phonograph.

Mr. Arlen making a practice record to test voice.

Rubber Pavement in London

A STREET paved with rubber bricks that eliminate heavy traffic vibration on adjoining buildings and houses is a reality in London. Bridge Street, leading to Ludgate Circus, is partially paved with Gaisman rubber blocks. This thoroughfare carries an enormous amount of heavy traffic.

Tests have been made in buildings of the same construction as those facing the rubber street, and results show that a decrease of 40 per cent is realized in the vibrations which shake the structures.

Cost has been estimated at about $20 per square yard, including the concrete base on which the blocks are laid.

While initial expense is great, rubber pavement will outlast other material by 20 years, according to rubber experts.

Alfred J. Lyddon, representative of the Ministry of Transport in Leeds, recently gave out some interesting figures in regard to rubber roadways. He acknowledged that he was dealing with an unknown quantity as compared with other material, but taking the life of granite setts at 20 years, wooden blocks at 10 or 12, and asphalt at seven or eight years, he would assume a life of 40 years for rubber. Vehicles will also ride easier on the rubber surface.

"The Three Women Musketeers of the Air" Set Records

Practically every women's aviation record worth having has been held at one time or another by the "Three Women Musketeers of the Air" pictured above. Miss Elinor Smith, at left above, is present holder of the women's endurance flight record of 26 hours, taking the title away from Bobby Trout, right above. In the center below is Louise McPhetridge, altitude record holder.

THE United States army air corps has its three crack pilots, better known as "The Three Musketeers," and the navy has its three champion flyers who are usually referred to as "The Three Sea Hawks," but the entire United States has applauded the feats of three other flyers who have become known as "The Three Women Musketeers of the Air."

One of the three is Bobby Trout, who is 18 years old and does most of her flying around Los Angeles. Back in January she set a record for sustained flight for women by remaining aloft 12 hours.

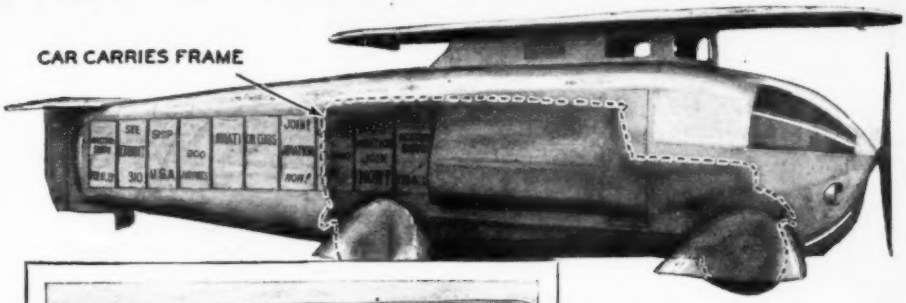
This news reached the ears of Elinor Smith, 17-year-old veteran flyer of Freeport, New York. She went out to Mitchell Field, fueled her biplane, and took off for a cruise over Long Island which ended 13 hours later with the setting of a new record.

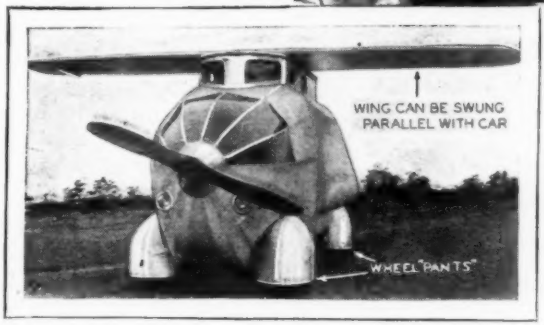
News of this feat reached Miss Trout, who promptly went out and beat Miss Smith's record by staying aloft for 17 hours. She also established a new record for night flying.

Louise McPhetridge, of Oakland, Cal., was next to have a try at the record-setting business. Taking off from the Oakland airport, she remained aloft for better than 22 hours, and on a later flight established a women's altitude record for this country of 20,270 feet.

And then Miss Smith, not to be outdone, took off in her monoplane on April 23 and came down the next day with the endurance record safely in her possession once more, after a flight of 26 hours 21 minutes and 32 seconds.

Amphibian? Dirigible? No, Just a Common Automobile





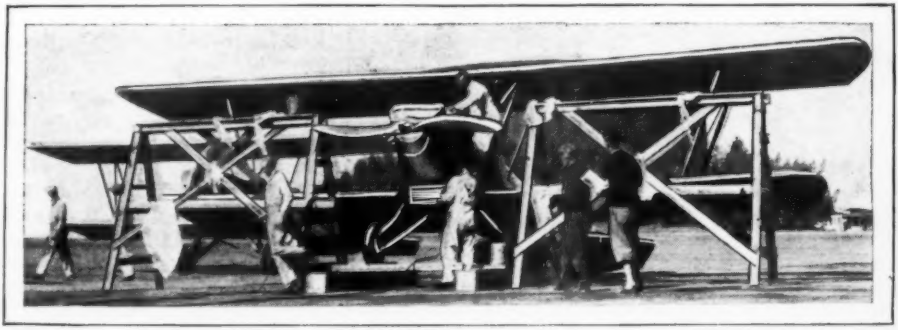
THIS strange looking craft shown above is not meant for service in the air. It is used merely to attract attention—and it does just that. Touring the principal airports of America, this mystery ship, the "mono-dirigible," was built for Frank Bolger, president of the Associated Aviation Clubs, Inc.

The odd-looking ship is of all-metal construction and because of its weight and bulk could not possibly fly. It is used to advertise air shows and create more wide-spread interest in aviation.

It consists of a metal frame attached to an automobile, as shown in the diagram above. The single wing is on a swivel so that it can be turned parallel with the length of the car in a narrow lane of traffic or going under bridges or viaducts.

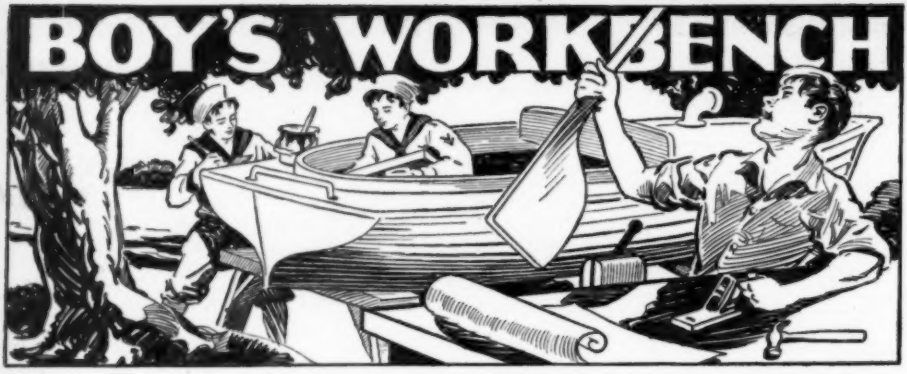
First Airplane Wash-Rack Helps Preserve Condition of Ships' Wings

CAR wash racks have been in existence almost as long as cars have themselves, but until recently there has not been a single wash-rack for airplanes. The Aero Corporation of California observed this fact and inaugurated an airplane washing service that thoroughly cleans a ship of grease and oil "while you wait." Under parts of the fuselage collect a large quantity of dirt, and landing gears are often covered with mud and grime. Washers first bathe a plane with a harmless chemical that eats away the grease and dirt. Water is applied before the ship is polished.



Crew of attendants of this new airplane washing service clean, dry and polish a ship in 15 minutes.

BOY'S WORKBENCH



Boats, pushmobiles and all sorts of outdoor vehicles are being built now to answer the call of the open.

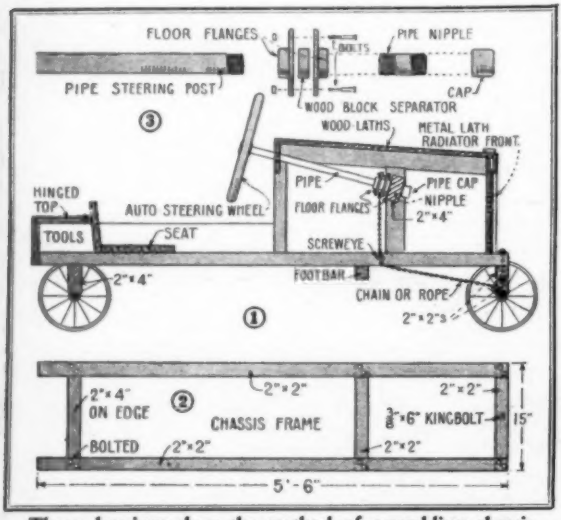
Edited by A. NEELY HALL

As author of such well-known books for boys as "The Boy Craftsman," "Carpentry and Mechanics for Boys," etc., A. Neely Hall is known to young handiworkers all over the country as an authority in his line. In this department, which appears every month in Modern Mechanics, Mr. Hall presents his latest designs for articles which boys can make in their own workshops.

This Speedy Pushmobile Looks and Runs Like Real Racer

THERE are more models of pushmobiles on the street than of automobiles. Indeed, you seldom see two homemade models alike. Each builder has his own notions about design and construction, and though he may pattern his car after this or that model, by the time he has shaped up his ideas, and hung on accessories, the contraption bears little resemblance to the original. A fine thing, that of using one's noodle in devising models.

The accompanying photograph shows a clever job in a racing car built by Billy Banks, twelve years old. The exhaust pipe and manifold borrowed from an old flivver is a hot idea, and it may tip you off to possibilities for other adaptations of parts from auto graveyards and garage junk piles.



These drawings show the method of assembling chassis and steering gear of a speedy model racer pushmobile.

Figure 1 of the pushmobile diagrams is a cross-section of a well proportioned chassis and hood, Fig. 2 is a plan of the chassis frame, and Fig. 3 shows details of a good rig in steering gears. Note well these specifications before designing your next car.

Two-by-twos, obtainable at every lumber yard, are of the right size for the side rails of the chassis, also for the front-wheel bolster and the footbar, and two pieces spiked together, or a piece of 2-by-4, should be used for the rear wheel bolster. The best way to assemble the frame members is with bolts. Quarter-inch carriage-bolts are of the right size.

Exhaust Manifold Salvaged From Junk Pile Gives Speedy Appearance

Wheels are of great importance in building a speed model. Don't be satisfied with anything short of rubber-tired, ball-bearing wheels, and five of them at that, to provide for a spare.

The hood can be built with a wooden framework, and covered with lath, lattice strips, box boards or wallboard. But a sheet metal hood is to be preferred, and it will not set you back much to purchase a sheet or two of galvanized iron.

You will have no difficulty in picking up a discarded auto wheel. Figure 1 shows how to mount it upon an iron pipe post, with pipe-fitting rig for operating steering chains or ropes. Two pipe floor flanges (Fig. 3), bolted together with a wood block separator form a spool to take up the slack of the chains. The steering post is screwed into one of the floor flanges, a pipe nipple is screwed into the other, and a pipe cap is screwed on the nipple. The nipple must be of the right length to extend through the 2-by-4 support (Fig. 1). Connect the steering chains or ropes to the bolts that join the floor flanges, run them through screweyes or pulleys on the frame rails, and fasten to screweyes in the front wheel bed block.

Expanded metal makes an excellent radiator front. Trim the edges with narrow boards. Use a can cover for a radiator cap. Build a tool box on the rear of the body.

Of course you will not brand your car as an old model by omitting the paint job. You can get the latest shades of auto enamels and lacquers at the paint stores. Painting a new pushmobile is what the boys call the "great adventure."

Scissors as Dividers

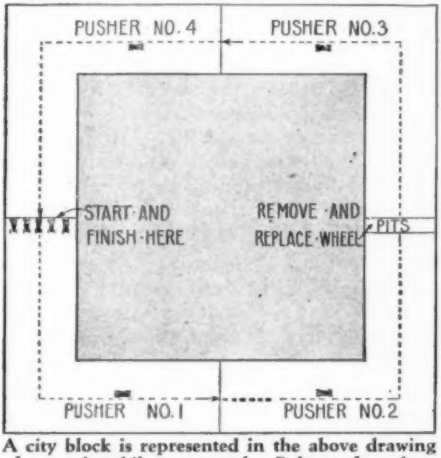
WHEN dividers are not at hand and such a tool is needed for dividing or scribing on some unexpected little job, a pair of common scissors can be quickly converted into a practical substitute. Tie a lead pencil to the top of one of the thumb or finger holes. Let the pencil rest over the other hole where it can be firmly held with the thumb and fingers against the handle. In this manner the points of the scissors are securely and rigidly held apart to the desired distance, but at the same time with no clumsy or inconvenient effort. This practical little stunt is worth remembering.

Through the addition of an exhaust manifold salvaged from the junk pile, this pushmobile model takes on the fleet lines of a real racer.

Pushmobile Race Course

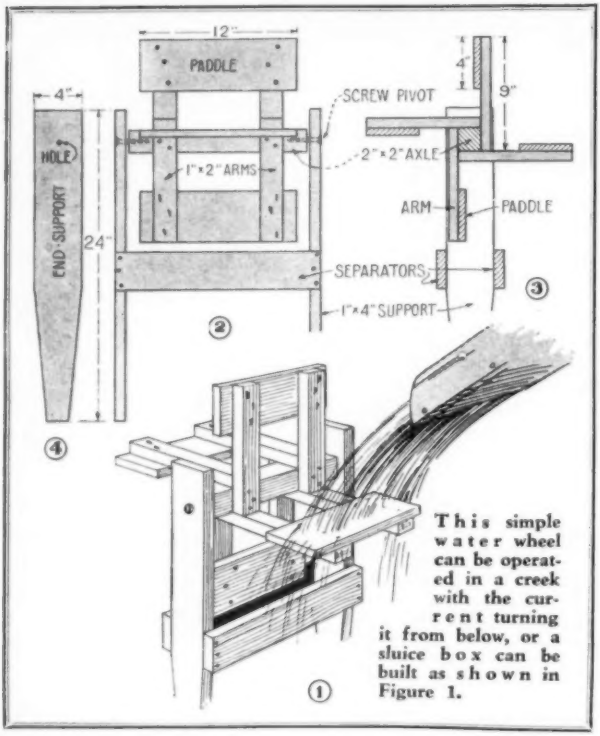
THE accompanying diagram shows a layout for a pushmobile course that has proved successful. It represents a city block, usually the equivalent of a half mile.

The scheme requires a driver and four pushers, or mechanicians, to each pushmobile. The pushers work in relays, one to each quarter of the course. Pits are located at the halfway point, and it is generally required that each pushmobile shall stop at this point, while a wheel is removed, then replaced. It is of the utmost importance that one wheel of each car be so mounted that it can be taken off and put on speedily. Ingenuity here counts for much.



A city block is represented in the above drawing of a pushmobile race track. Relays of pushers and pits for repairs are provided in the diagram.

Water Wheel Is Good Source of Power for Running Toys



This simple water wheel can be operated in a creek with the current turning it from below, or a sluice box can be built as shown in Figure 1.

HERE is a simple rig in a water wheel that will afford you as much fun as a more complicated model. If you spend your vacation near a river, set up the wheel so the current will turn it from below. Or, if the stream is small enough, build a dam and place the wheel so that it will be operated from above. A spring is a source of current readily adapted, and those of you who have no access to natural currents, may employ a garden hose. Figure 1 suggests how the model would be operated with water from a sluice box.

This water wheel can be knocked together quickly. You will note by the front elevation (Fig. 2) and the cross-section (Fig. 3) that the wheel consists of an axle, eight arms and four paddles. Each paddle is nailed to a pair of arms, and the ends of the arms are nailed to the axle, one pair to each face of the axle. With the paddles and arms mounted alike, the wheel will be symmetrical. For mounting the wheel, two end supports (Fig. 4) are needed, and two separator strips. Taper the lower end of the supports, as shown, and bore a hole near the top for a screw pivot. The hole should be large enough so the screw will turn freely in it. After mounting the wheel between the end supports, cut the separator strips of the correct length to fasten across their side edges.

After you have set up the wheel, you may want to utilize the water power to operate toys. Here is an opportunity to exercise your ingenuity in rigging up spool pulleys, dowel-stick shafting and string and rubber-band belts.

If you care to go to a little extra work, a more elaborate and more efficient water wheel can be built by adding a length of tin to each paddle wheel, turned up at the bottom in a scoop-like shape which has the effect of holding the water in pockets so that the wheel turns more steadily.

Brush Finish for Brass

BRASS and similar metals may be given a brush finish by rubbing with steel wool, care being taken to rub only in one direction, otherwise a scratched surface will result. A lacquer should be applied when finished to prevent tarnishing, the most satisfactory being a thin solution of white shellac in alcohol, applied with a brush. Small pieces can be dipped in a large container of this solution.

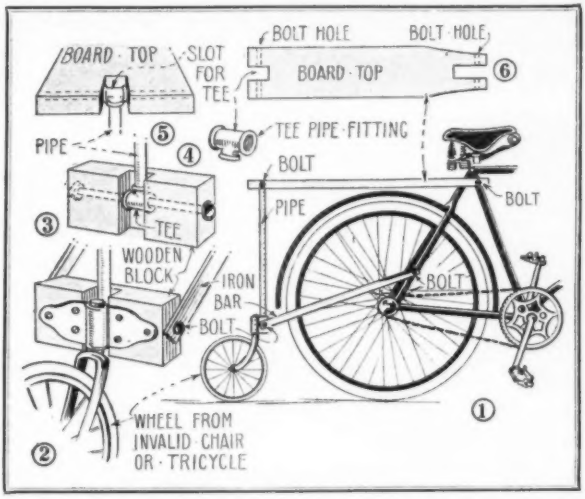
Staining Hardwoods

WHEN staining hardwoods pour the oil to be used into a separate container and add approximately one-eighth the amount in varnish. This oil-varnish mixture provides a good undercoat in any case and is especially useful if the article is to be given a wax finish.

Bicycle Luggage Carrier Just the Thing for Camping Trips

YOU fellows will soon be chasing the horizon, on your bikes, and here is a rig for packing pup tent, blankets, or what have you.

The rear rigger shown in Fig. 1 of the diagrams requires a small rubber-tired wheel with fork and swivel mounting. The small wheel on an invalid chair is just what you need. You may be the lucky boy to find a broken chair from which you can appropriate a wheel. As a substitute wheel, scout around for the front wheel of a tricycle.



For carrying baggage on a bicycle it's hard to beat the little luggage carrier shown above. It is not difficult to make.

You need besides the small wheel a 2-by-4 block, tee pipe fittings, iron pipe, iron bars and bolts, for the rigger frame, and a board for a top. Sizes for the parts are not given on the diagrams because they will be determined by the diameter of the rigger wheel and the form of swivel mounting. But ½-inch pipe with tees to fit, ¼-inch by 1¼ inches iron bar, and a 1-by-8 or 1¼-by-8 top board, will be heavy enough for the job. If there is a pipe cutter and threader among Dad's shop equipment, you can cut and thread the pipe yourself, and with a hacksaw and metal drills cut and drill the iron bars. Lacking them, take the pieces to a plumbing shop.

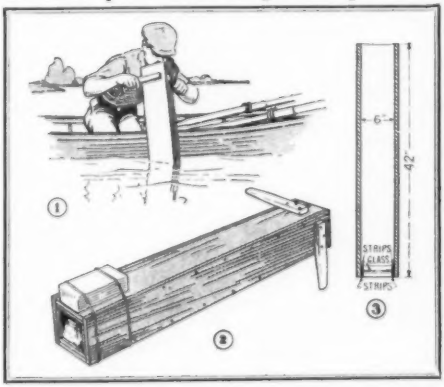
Figure 2 shows how the swivel wheel is fitted and screwed or bolted to a 2-by-4 block. The pipe upright and the side bar braces are also connected to this block, and Fig. 3 shows how. Notch one face of the block to receive the tee pipe fitting, and drill a hole through the block from end to end, of a diameter equal to that of the tee, for the connecting bolt. The bolt used here must be long enough to run through the bars and block and take washers and nut.

A similar swivel connection is made with the board top (Figs. 1 and 5), with tee fitting and a bolt extending through the board from side to side. The forward end of the board is bolted to the bicycle frame (Figs. 1 and 6), and so is the end of each of the side bars. To prevent the bolt nuts from working off, drill the bolt ends and drive cotter pins through the holes.

A Water Telescope

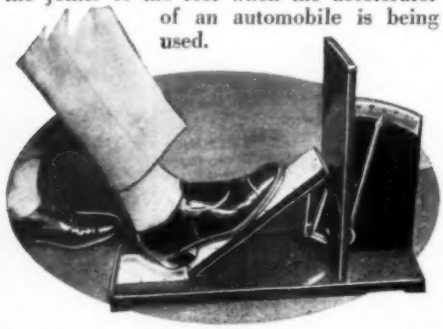
FIGURE 1 of the diagram shows how the water telescope is used from a boat in searching for under-water objects. Figure 2 shows a detail of the completed model, and Figure 3 shows a cross section.

First, build a box with open ends. The dimensions are given in Figure 3, but you can alter these as you see fit. Inside tack a strip to each side, about 1½ inches from the end. Then fit a piece of glass in the box to rest upon the strips, fasten another set of strips to hold the glass in place.



Machine Tests Sensitiveness of Foot on Car Accelerator

HOW sensitive the balls of the feet and tips of the toes are is established by the apparatus shown in the photo below. It was invented to test the sensitiveness of the joints of the feet when the accelerator of an automobile is being used.



The gauge of this machine measures poundage of foot pressure.

Leviathan Now Privately Owned

ON THE seventh anniversary of her last sailing as a military transport, the S. S. *Leviathan*, which carried many thousands of American doughboys safely to France during the World war, passed out of control of the United States government.

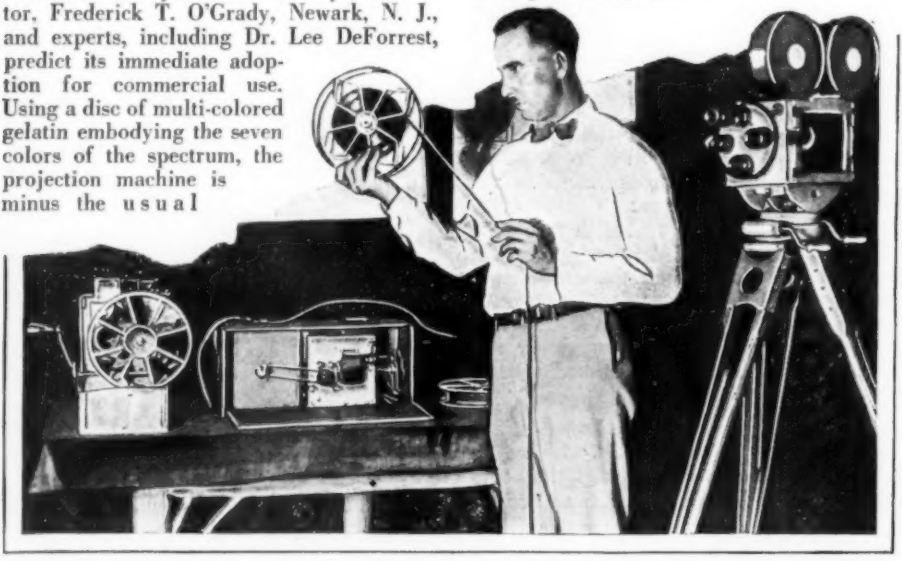
An informal ceremony was recently held aboard the giant liner as she lay at her dock. A deed and a check for $4,000,000 were exchanged whereby the flagship and ten other vessels of the United States Shipping Board and American Merchant Lines became the property of the United States Lines, Inc., of which Paul W. Chapman is head.

Commodore Harold A. Cunningham, captain of the *Leviathan*, led Miss Joanna Chapman, the president's 15-year-old daughter, to the taffrail, where she raised a new flag in the place of the ship's old blue pennant.

Revolving Discs of Spectrum Hues Afford Natural-Colored Movies

MOVIELAND'S blonds and red heads who now appear on the screen to be brunettes of varying degrees will be real blonds and real brunettes when a new process recently developed for making natural colored pictures is adopted by motion picture producers.

It was recently demonstrated by its inventor, Frederick T. O'Grady, Newark, N. J., and experts, including Dr. Lee DeForrest, predict its immediate adoption for commercial use. Using a disc of multi-colored gelatin embodying the seven colors of the spectrum, the projection machine is minus the usual shutters. This system is a radical departure from all other methods of coloring photographs. The color disc, revolving in front of the film and behind the lens, registers the natural color on the exposure. These are projected on the screen at a slightly faster rate than the ordinary black and white pictures are run.



Movies showing the real color of stars' hair, eyes, complexion and frocks possible with this device.

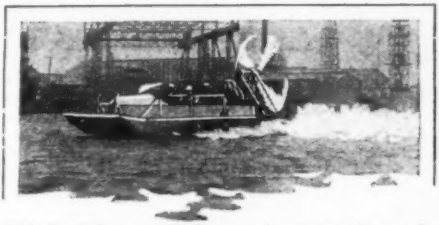
Air Propelled Speed Boat Skims Over Six Inches of Water

SKIMMING over water 60 feet deep or only six inches makes no difference with this hydroplane boat, shown at right. The hull slides smoothly over the surface at a speed of 50 miles an hour.

This craft, which has a length of 24 feet and a beam of ten feet, is powered by an airplane-type engine and an air propeller. It is built in five separate compartments, joined by deck stringers and thus forming a semi-rigid hull. Each section is constructed of wood, covered with fabric and sheathed with thin duralumin metal.

A radiator is placed between two of the sections in order that it will be in contact with the water. This helps to serve as a means of cooling.

Chains running from the motor drive the propeller. With three persons on board, a speed of 50 miles an hour is maintained steadily. A full load lessens the speed to about 40 miles an hour.



This boat is propelled over the water 50 m.p.h.

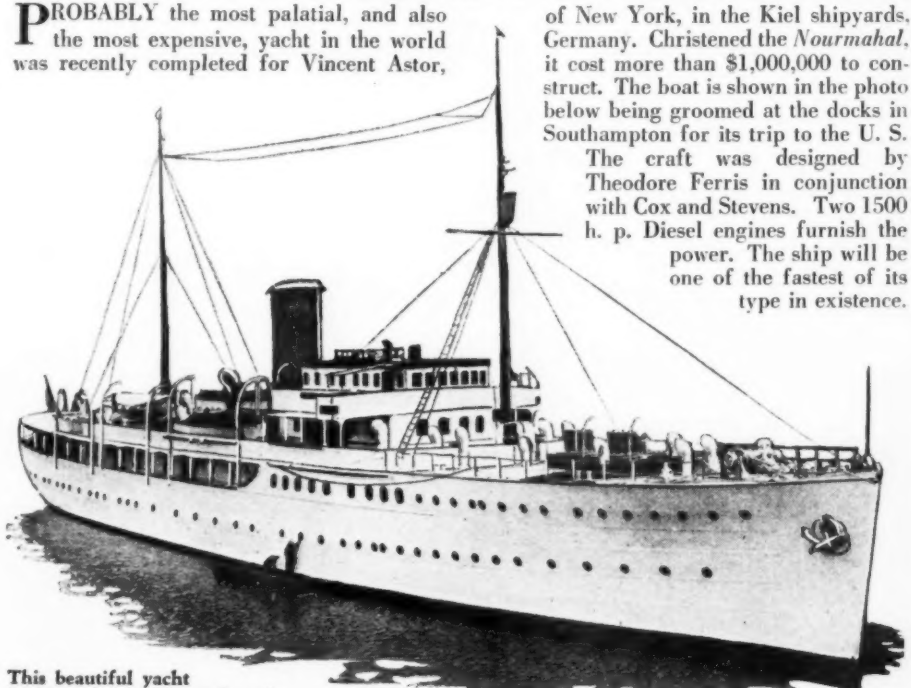
Jail "Tenants" Live in Style

NOW that the new $2,000,000 jail has been completed in Hudson county, New Jersey, officials are afraid that everyone in the county is going out and commit a misdemeanor in order to enjoy the comforts which the jail affords.

Marble halls, washrooms with showers, a hospital, a model kitchen, a stage and assembly are some of the conveniences and luxuries in the new jail.

Vincent Astor's Million Dollar Yacht Is One of Finest in the World

PROBABLY the most palatial, and also the most expensive, yacht in the world was recently completed for Vincent Astor, of New York, in the Kiel shipyards, Germany. Christened the *Nourmahal*, it cost more than $1,000,000 to construct. The boat is shown in the photo below being groomed at the docks in Southampton for its trip to the U. S. The craft was designed by Theodore Ferris in conjunction with Cox and Stevens. Two 1500 h. p. Diesel engines furnish the power. The ship will be one of the fastest of its type in existence.



This beautiful yacht is shown being prepared at the docks at Southampton, Eng., for its trip to the U. S. It was built in the Kiel shipyards, Germany.

RACING Over WATER at ~

This new Hydrofoil racer threatens to shatter the world's speedboat record of 93 miles an hour! Charles Hall, one of Modern Mechanics' boating experts, relates thrills from trial run.

ONE HUNDRED miles an hour to a new world's speedboat record! The "Hydrofoil," latest development in nautical speed crafts, will make that rate with a 550 h. p. motor, according to Philip L. Rhodes, naval architect, who designed the boat.

Gaining speed, the boat lifts clear of the water by a system of submerged planes that are not a part of the hull itself.

As the speed increases, the foils lift the boat from the water until at a rate of about 70 miles an hour it is running on a surface of only one and a half feet of hydrofoil. The conventional speedboat of the same size requires about 30 square feet of water while going at the same speed.

Charles H. Hall, one of MODERN MECHANICS' boating experts and formerly editor of "Motor Boating," recently had the privilege of taking a "spin" in the new boat, which only seats the driver and one passenger.

He said of his experience:

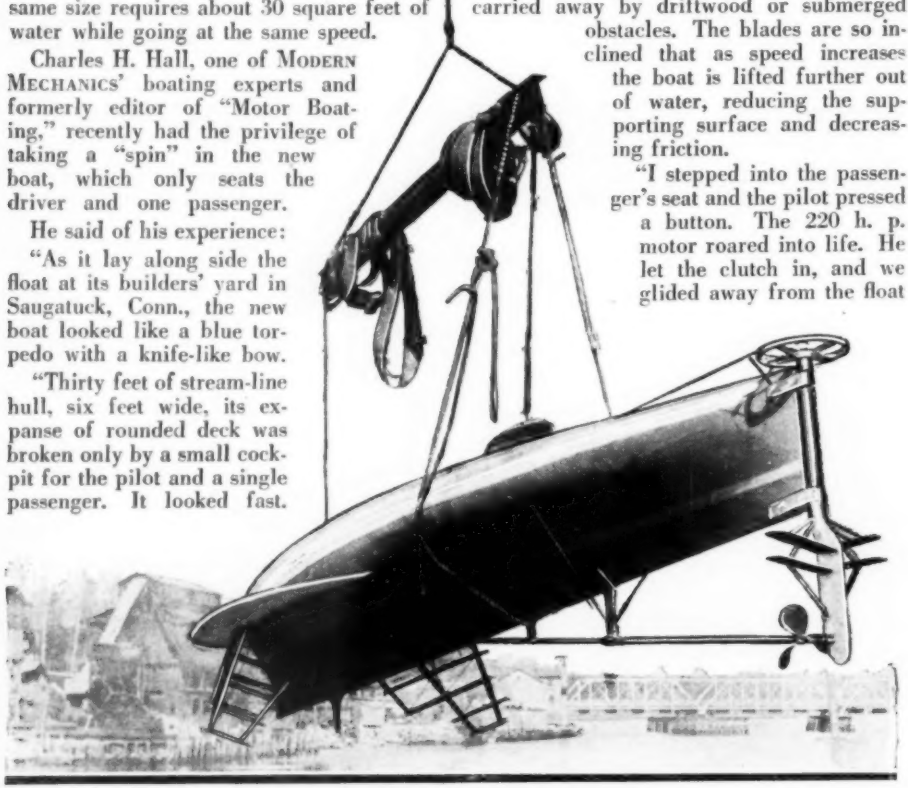
"As it lay along side the float at its builders' yard in Saugatuck, Conn., the new boat looked like a blue torpedo with a knife-like bow.

"Thirty feet of stream-line hull, six feet wide, its expanse of rounded deck was broken only by a small cockpit for the pilot and a single passenger. It looked fast.

"A light spray board ran along each side forward, to keep the flying water from blowing aboard when it was starting. But the oddest feature of this new racer was the supporting hydrofoils, two sets on each side and one on the rudder.

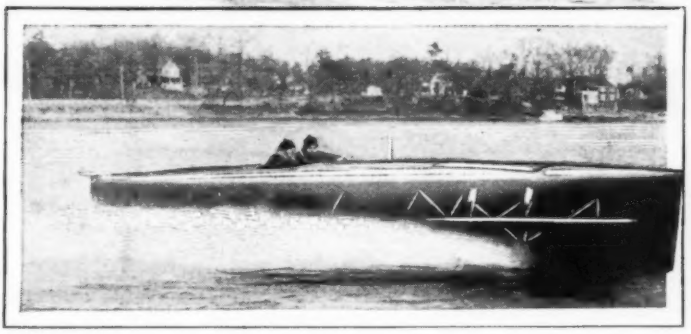
"These are curved plates, shaped like airplane wings. Four of them comprise a set, one above the other. Their supporting structure inclines down and in. The lower foils are used most and extend below the keel. The preventers are shorter in order that they clear the water at speed. They come into action only if the lower ones are carried away by driftwood or submerged obstacles. The blades are so inclined that as speed increases the boat is lifted further out of water, reducing the supporting surface and decreasing friction.

"I stepped into the passenger's seat and the pilot pressed a button. The 220 h. p. motor roared into life. He let the clutch in, and we glided away from the float



This racer was suspended from a crane to give a clear view of the ladder-like hydrofoils. When in the water, these hydrofoils act on the same principle as airplane wings in the air. At top speed, the boat skims along on the lowest step of the hydrofoil.

One Hundred Miles an Hour



Charles H. Hall, one of Modern Mechanics' boating experts, is shown getting a ride. The craft is driven by a 220 h. p. engine and gains its tremendous speed when its hull rises from the water on its hydrofoils. The only friction, therefore, comes on about one and a half square feet of foil!

with scarcely a tremor. The boat slipped smoothly over the water and there was none of the bumping and neck-snapping jerking that usually accompanies a high speed racer.

"At first a little spray was thrown off by the hull, but it climbed higher and higher as we moved faster. At 20 miles an hour the boat was clear of the water's surface and its 3,000 pounds of weight was carried entirely by the hydrofoils. Then it moved!

"The keen wind whistled past our ears, and the needle of the special airplane speed indicator started to creep around the dial. The big boat handled beautifully, answering every touch of the wheel and swinging around bends of the river like a big runabout. It leaned inward on the turns as a good boat should and in sloppy water lifted easily but did not pound.

"We headed back for the float and the pilot put it alongside with less trouble than it takes to swing your car in close to the sidewalk."

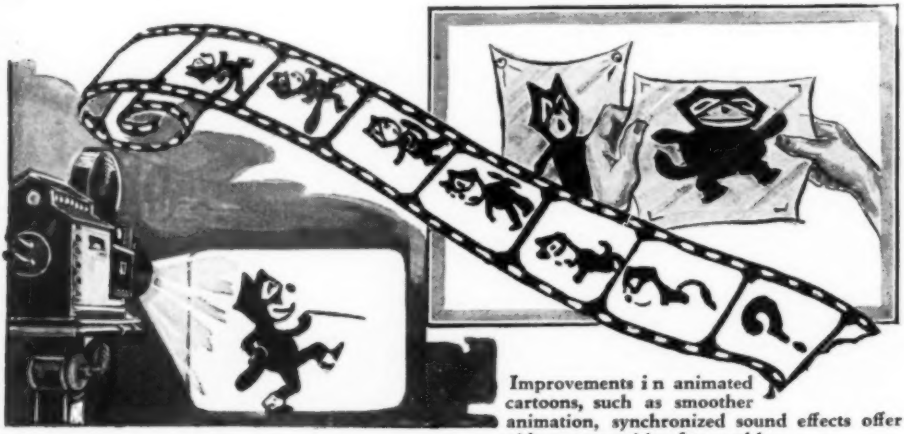
Philip Rhodes designed the new racer in co-operation with F. W. Baldwin under the Baldwin patents. It was built by the Ollendorf Boat Company, Saugatuck. Plans are being made to attempt to break the recent world's speedboat record of 93.2 miles an hour made by Gar Wood.

Wood's record was made in the second day of competition with Maj. H. O. D. Segrave, British driver, who was awarded the race when the American's steering gear broke the first day and he was required to drop out. The title was based on points, and the necessity of dropping out of the race the first day took away so many points from Wood's score that even though he broke his own world's speed record the next day and left Segrave far behind, the Englishman was declared winner.

Rhodes and Baldwin believe that the Hydrofoil racer can beat either Wood or Segrave.

The craft has attracted much attention among speedboat authorities throughout the United States and Great Britain. Its unusual design and principles of construction are expected to revolutionize motor boat racing.

IDEAS for NEEDED



Improvements in animated cartoons, such as smoother animation, synchronized sound effects offer wide opportunities for wealth.

HERE are ideas for inventions which are needed in four different industries. Some of the suggestions are specific, and others are general, but they all show fields in which the producers are looking for a product which can be greatly improved with the requisite inventions.

For instance, in the making of animated cartoons, there is a need for smoother animation. More so nowadays than ever before, because the animated cartoons will shortly be set to synchronized sound effects, and the characters will talk, laugh, and chuckle just as characters in the regular "talkies" do!

Some method of securing smooth animation must be conceived. There have been drawings on gelatin sheets, and various contraptions to give the fluidity of line so necessary to secure lifelike animation, but the problem has not been solved by a long way. Get busy on this one! To the man who can make cartoons move with lifelike freedom, without jerkiness, there is a fortune waiting!

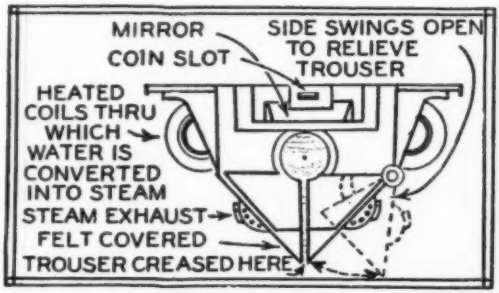
Saxophone artists pride themselves on being able to secure amazingly sweet "singing" effects, that is tremolo effects such as an organ has, by proper manipulations of the fingers and lips. However, this effect is obtainable only after years of practice, and beginners' efforts are lacking in this sweet singing effect. Saxophone manufacturers for years have been looking for a reed which would give the same tremolo effect that even a mouth organ possesses. Such a mouthpiece would greatly improve the beginner's playing, and would make saxophones much more popular. A suggested method of attacking the solution of this problem would be to try a reed on the inside of the mouthpiece which would be made to vibrate sympathetically with the tone reed on the bottom. However, it should be a shade off in pitch, so that the tones will "motorboat," or heterodyne, giving the tremolo effect.

For really big rewards, here is the prize of opportunities. The aircraft industry is dependent upon the finest of chrome molybdenum steel tubing for the main parts of the aircraft it builds, such as the fuselage. This must be welded and in the present methods of hand welding, skill is the chiefest and dearest commodity. A machine which would so control the heat (automatically) that perfect welds, either in jig form or straight butt welds, could be made with unskilled help feeding the machine would immediately spell fame and fortune for its inventor. Rent it on a royalty basis.

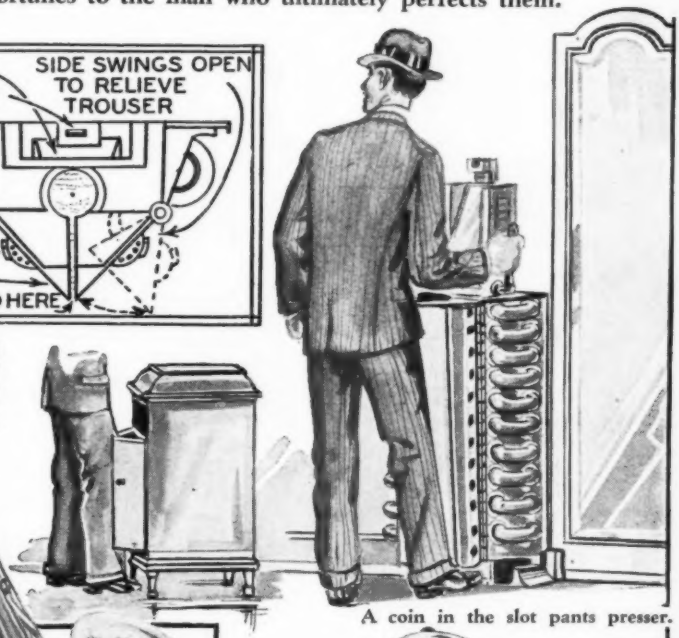
Then there is the unique idea suggested to one of the editors of MODERN MECHANICS upon finding his trouser leg caught in the folding doors of a phonograph cabinet.

INVENTIONS

Here are four ideas which are capable of being developed into inventions which will fill crying needs in four different industries. Each is widely applicable and should net comfortable fortunes to the man who ultimately perfects them.

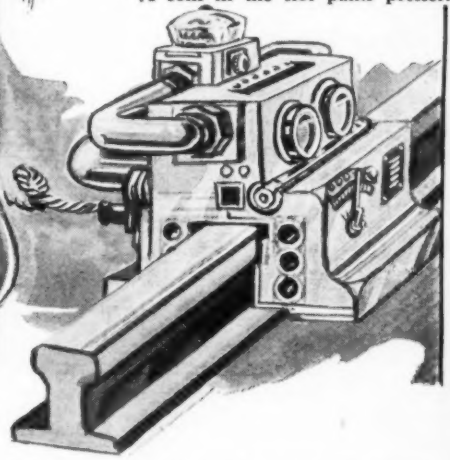


The accidental catching of a trouser leg in the doors of a phonograph cabinet, was the inspiration of the pants presser.



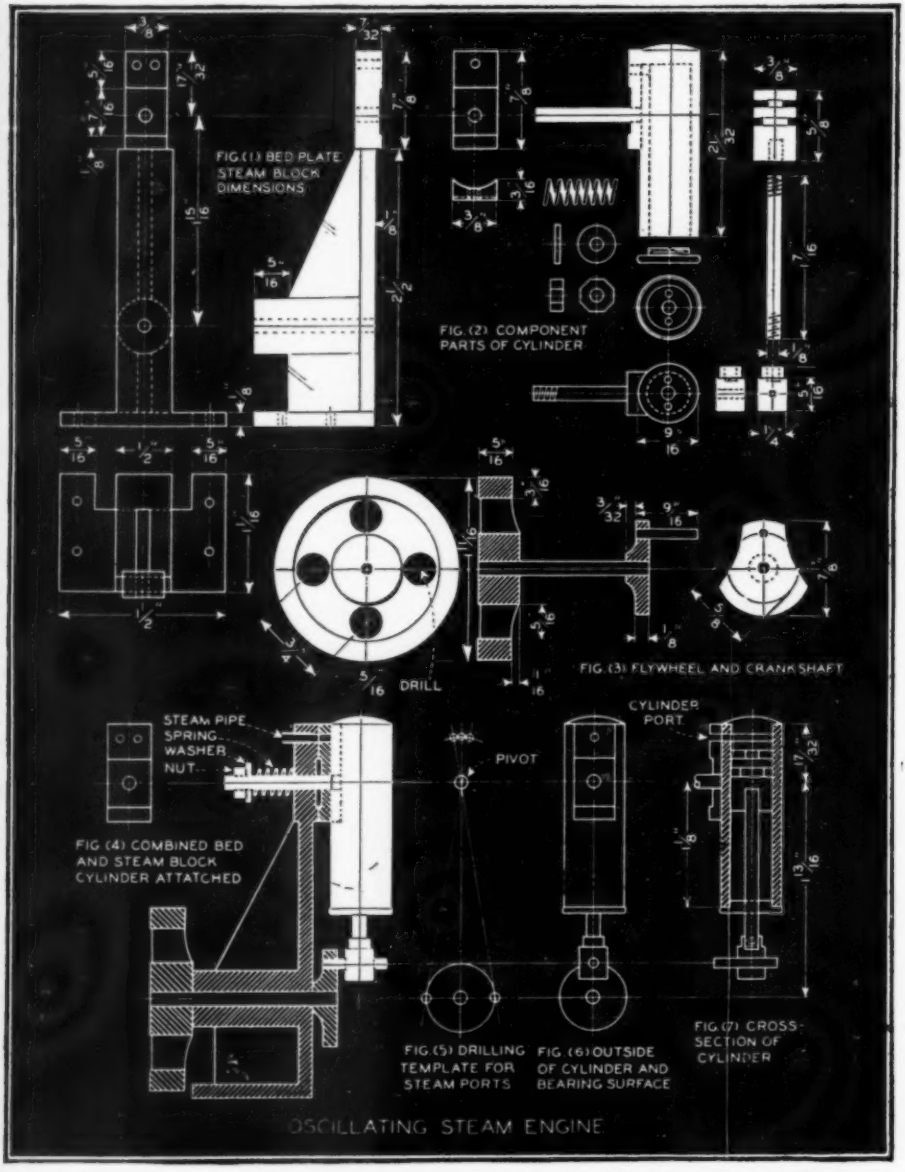
A coin in the slot pants presser.

The beautiful singing effect of the pipe organ is given because of the tremolo effect imparted the air flow to the pipes. If saxophone manufacturers could end the hunt that has been instituted for a reed which will give a tremolo effect, rich royalties would be paid. Above is a suggestion for attaining the desired singing tone.



Badly needed in all metal industries is an automatic welding machine, pictured above.

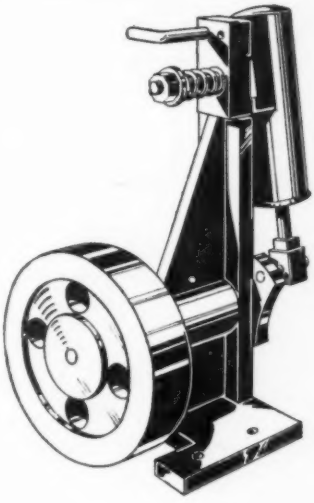
Simple Oscillating Steam Engine Is Capable of Driving Model Boat



Design for a simple oscillating engine, so called because the cylinder oscillates to admit steam to the valve ports, is that of an engine built and tested by Mr. Allen. It is made entirely of brass with the exception of the piston rod and crankshaft, which are of cold rolled steel. Above, all the working parts are shown, fully dimensioned, and the way in which the valves are ported is shown in figs. 4 to 7. This engine is single acting and will drive a 30-in. model hull 2 - 3 m.p.h.

MODEL ENGINE *for Driving* Boys Toys

By THEODORE ALLEN



OSCILLATING STEAM ENGINE

Built to drive small model boats, derricks, meccano designs, etc., this engine requires but little machining, and is very powerful.

WHEN spring has passed and summer finally comes into her own, it's great fun to tinker with the models you have spent the winter scheming about.

Especially are model boats a lot of fun. Americans are just waking up to the wonderful fun to be had with the fruits of the model maker's art, and being a nation of boat enthusiasts it is only natural that the model boat comes in for its share of attention.

But to have worthwhile model boats we have to have power plants which really function, and there is the rub. Here's an engine of the oscillating type which will be easy for anyone at all mechanically inclined to build, and which will work well in a model boat in connection with a pot boiler of about a pint and a half capacity, alcohol lamp fired. The engine will drive a model 30 inches long with ease.

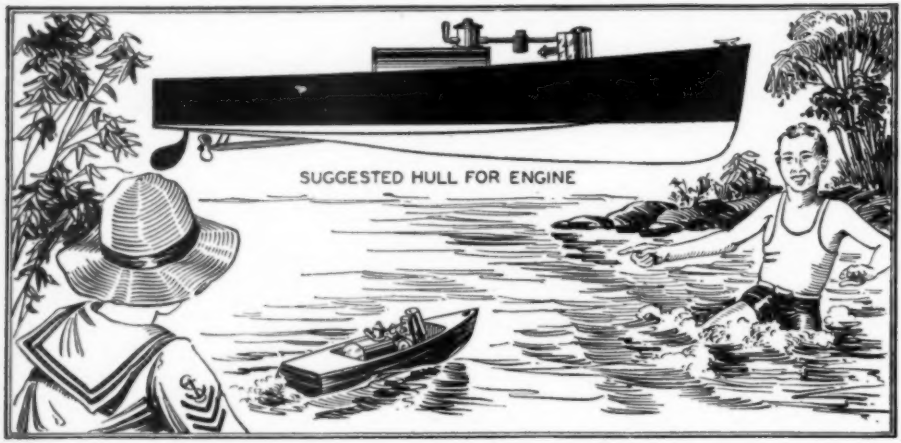
There is but one pattern to take a casting from. This is the motor bed and bearing. The dimensions of this are shown plainly in the drawing and there is no need for a detailed explanation here. The pattern will need but one casting taken off, and there is therefore no need to make it a split pattern. The foundry man to whom you take the pattern for a casting can cope the sand down around the solid pattern cheaper than you can build a split one, so make the pattern solid.

The base of the bearing standard can be filed off flat, and also the face of the valve openings. The bearing can be drilled by hand, and the valve openings also. The pivot rod is handled with the idea of securing it to the block which faces the valve seats so that it is tightly against the cylinder. See fig. 2 in the blueprint. The way this is fastened is to sweat it in with solder.

The cylinder is a piece of brass tubing, cut to length, with the hand filed valve face sweated on as just mentioned. The valve face is $\frac{7}{8}$ inches by $\frac{3}{8}$ inches, and of brass, as are all the working parts except the crankshaft and the piston rod.

The crankshaft is simple and needs no explanation. It is a length of $\frac{5}{32}$-inch c. r. s. rod. The crank disc is cut out as shown, and the crank pin hole drilled.

Suggested Design of Model Boat for Use With Oscillating Steam Engine



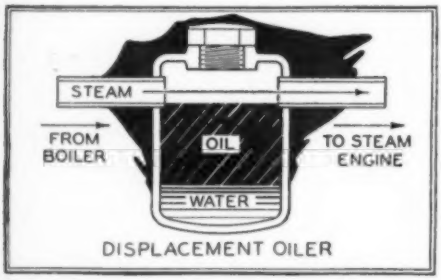
Using a simple copper tube pot boiler, about 5 inches long by 2 inches in diameter, the simple oscillating engine described in this article is capable of driving the model boat above at 3 m. p. h.

Then the disc is heated to about the temperature of boiling water and the web shrunk on. It should fit tightly.

The flywheel is a simple turning in brass which you can do at home if you have a lathe, or which you can get a machine shop to do for a small amount.

There is really nothing about the engine which is difficult or hard to understand. The valves are laid out as shown in figure five and the layout from figure four to figure seven will show you how the piston, valve and crank are laid out and assembled.

The adjusting of the pressure of the valve



A displacement lubricator for the engine can be made by following the diagram above. Condensed water displaces the oil.

faces I found was the only ticklish part of running the engine and tuning it up. You will find, as I did when I built my engine, that the tension of the valve spring will have to be adjusted to the right degree to ensure smooth action of the engine. The tension, if too tight, will give the engine a slower speed due to the friction of the faces, and if it is too loose, the steam will escape. The only way to get the right tension is to keep experimenting.

The engine has a piston in which waxed wicking is placed in grooves, the better to make a water tight and steam tight seal between the walls of the cylinder.

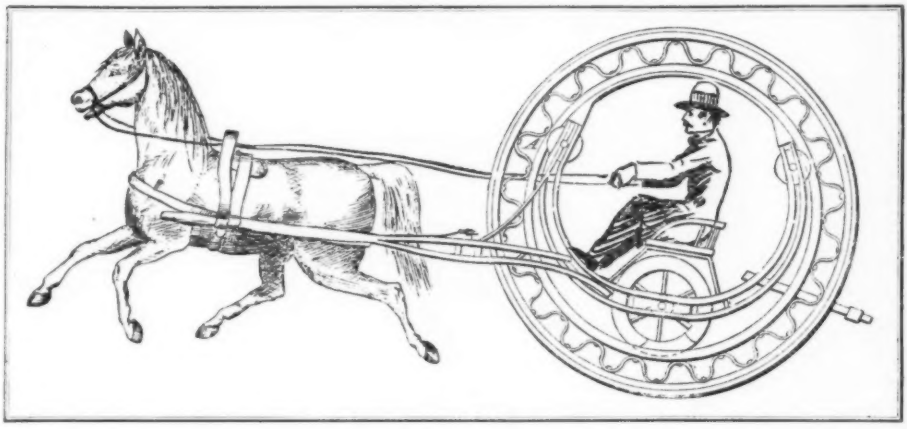
Shown on this page is a displacement lubricator of the type extensively used by the British in oiling their model steam engines. The English are great model makers, and have long experience behind them. Therefore the displacement lubricator can be used safely with assured results. It works on the following principle, being used between the engine and the boiler. It traps whatever moisture condenses in the steam line, and replaces the moisture with oil.

Above is shown a suggested type of boat for use with this engine. It is about 30 inches long, 7 inches beam, and is made v bottom of wood on the bread and butter system. The engine shown in this article will drive the boat shown about 3 miles per hour.

Another way in which the boat might be made was shown in an earlier issue of MODERN MECHANICS, where the sides were made of tin, the bottom of tin, and the pieces put together by soldering.

PATENTS *Nutty or Novel?*

These Extraordinary devices have all been granted patents by the U. S. Government



One-wheeled Sulky Would Make a Horse Laugh

THIS invention of a one-wheeled racing sulky even made the horse laugh; he doesn't seem to realize that the joke is on him. What with keeping his balance and trying to steer the horse and dodging out of the way of the revolving contraption above his head, the gentlemanly jockey preserves his poise in a manner to warm the heart of Emily Post. With the addition of a garland of hibiscus and jonquils to the rim of the wheel and a neckpiece of pink and purple taffeta around the driver's neck, the ensemble can be pressed into service in Easter Parades and Fashion Shows, thus affording the enterprising race track promoter an additional source of revenue. The inventor doesn't say just how the jockey maintains his balance, but it would seem from the picture that if he ever faw down he would go pretty much boom.

Parachute Fire Escape

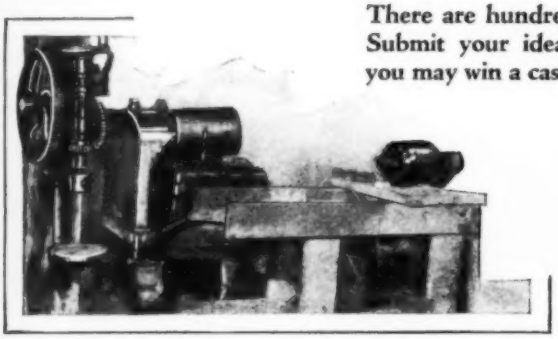
FAITH, hope, charity, and a strong jaw seem to be the qualifications for the chap who essays to use the extraordinary parachute shown below. The idea is that the device is clamped to the head when one goes to bed, so that in case the building burns down during the night the wearer can step out of a tenth story window and drop softly to the earth like the gentle rain from heaven. A pair of slippers with thick rubber soles is worn to lessen the shock of landing. The gentleman in the picture, appears to be traveling earthward at a rapid rate, as may be determined by the manner in which the tails of his Prince Albert are flapping in the breeze, but such is his confidence in the dependability of his chute that he is already shaking hands with himself.

Mustache Harness

A SIMPLE twist of the wrist, an easy loop of a rubber band around the ears, and this mustache harness is slipped in place where it has the situation, or rather the mustache, well in hand. Its purpose is to do away with the objectionable straining qualities of the approved type of heman walrus mustache, the guard holding the mustache in reserve while coffee, soup, oysters, and similar liquid comestibles are safely transferred from table to tummy. Persons subject to seasickness also report that the guard has helped them in times of emergency, though it is probable that this particular use was not contemplated by the inventor. The air of confidence on the face of the gentleman in the picture is itself a strong testimonial as to the efficiency of this invention in doing what it claims to do.

OLD FORDS Converted

There are hundreds of new uses for old Fords! Submit your ideas to Modern Mechanics and you may win a cash prize of $10. Try your luck!



This discarded Ford motor furnishes light and power for a ranch in Wyoming.

AMATEUR mechanics in every section of the country are tinkering with old model T Fords, or what is left of some of them, in an effort to transform their working parts to new and original uses in business, home life or pleasure.

From the response that MODERN MECHANICS is receiving in its New Uses for Old Fords contest, which runs every month, the editor is beginning to believe that persons are using everything but the squeaks and groans from these old cars for new and novel purposes.

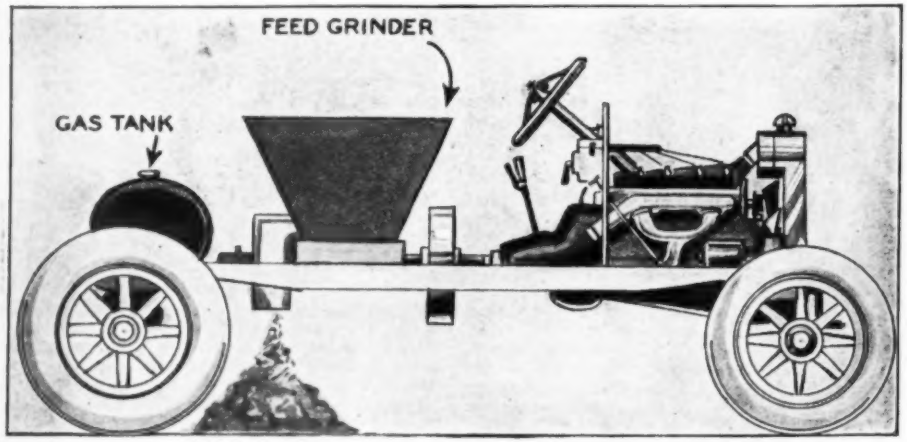
Four prize winners are named this month, and all are using old Fords to unusual advantage. The lives of these cars have been extended for at least four or five more years, and they are performing capably in their new capacities.

One of the best uses this month is that which Earl A. Montgomery, Torrington, Wyoming, is putting his old Ford to. He is using its motor to run a standard 32-volt electric generator furnishing light and power for his ranch.

He does not use a storage battery, but runs the motor whenever light or power is needed. One gallon of gasoline runs the plant for seven hours pulling a 300-watt load. Total cost of construction was less than $75.

"The difference in cost between my plant and that run by a commercial storage battery," Mr. Montgomery writes, "will run my plant several years."

The builder discarded pistons, connecting rods, valves and push rods from the three front cylinders, making it a single



This motorized feed grinder was made from a Ford motor and chassis by hooking up the drive shaft.

to New Uses Win Prizes

Geo. Dacy won $10 for this unusual photo of a Ford transformed into a narrow gauge locomotive.

cylinder engine. A regular Ford timer and coil are used. Both manifolds are left off and the exhaust and carburetor are clamped directly to the ports.

Of the entire outfit, the only parts that are not taken from a standard Ford car are the short piece of one-inch shaft that is machined to fit in place of the universal joint and the drive pulley which fits on this shaft.

Haakon Oppeboen, 1807 Hammond St., Chicago, Ill., conceived the idea of attaching a feed grinder to the drive shaft of an old Ford chassis.

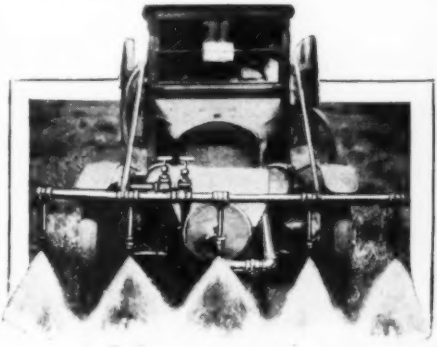
Feed is ground swiftly and thoroughly with this adoption, which does not require expert technical ability to adjust.

Transformation of an old Ford into a locomotive is not an everyday event. George H. Dacy, 4639 Montgomery Ave., Bethesda, Maryland, won $10 for his entry. Locomotive wheels have replaced the originals, and the "dolled up lizzy" hauls its ore cars over narrow gauge tracks from the mine where it is used.

Weed and grass fires are extremely hazardous in areas adjacent to large manufacturing plants and buildings. Constant vigilance proves of no avail where ignitable vegetation is tolerated.

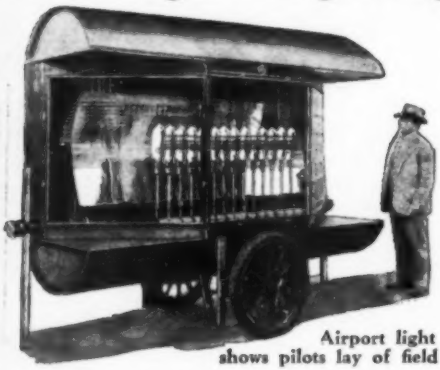
Special danger is placed on oil companies' bulk stations, where weeds and grass grow close to the storage tanks. Rhys G. Thackwell, West Englewood, N. J., solved this problem by attaching a chemical sprinkler to the front of his old Ford and spraying the objectionable weeds and grass.

There are countless more ideas for new uses for old Fords. If you have adapted an old Model T to some new use, get a photo of it and send it to MODERN MECHANICS at once. Ten dollars will be paid for all photos of new uses found acceptable for use in this department.



Device hooks onto Ford to kill weeds by spraying.

Throws Light Strong Enough to Read Paper Mile Away



Airport light shows pilots lay of field

SPREAD low over the ground, so that the beam does not blind a pilot in landing, this new airport light, shown at left, casts a light of 3,000,000 candle power. It is radically different from any now in use in that it has no circular lenses or mirrors.

The new light has been developed by C. A. B. Halvorson, designing engineer of the General Electrical company. It contains a row of 14 powerful incandescent lamps, sufficient to throw a beam enabling one to read a newspaper a mile away. It can be moved about with ease.

Gets Equipment in Record Time

WITHIN 40 hours after Commander Richard Byrd ordered some equipment by radio for his Antarctic expedition, the orders were filled in New York and carried across the continent.

Four rubber lifeboats were needed for the expedition. They were shipped by the National and Boeing air lines to the Oakland municipal airport, whence they were rushed to the S. S. Makura and were en route to Byrd's base at Dunedin, New Zealand.

This demonstration of speed is an illustration of what can be accomplished in the modern business world of today.

High Post in Navy to Shipbuilder

RECENT appointment by President Hoover of Ernest Lee Jahncke, New Orleans shipbuilder, to the position of Assistant Secretary to the Navy, has broken the so-called "Roosevelt tradition."

For the past 16 years some member of the Roosevelt family has occupied this office. In fact, even before this, Theodore Sr. himself held this important post.

This was the first public position he had and at the outbreak of the Spanish-American War he resigned from it to organize the famous "Rough Riders"

Sixteen years ago President Wilson appointed Franklyn D. Roosevelt, then a New York senator, to the position. He served in this capacity until 1921.

When Col. Roosevelt resigned to undertake his unsuccessful fight for Governor of New York against Alfred E. Smith, Theodore Douglas Robinson, nephew of "T. R.", took his place in the Navy department.

Need "Sixth Vitamin" to Grow

RECENT experiments with animals have proved that "lettuce and liver certainly contain a sixth vitamin." Dr. H. M. Evans, of the University of California, fed various animals chemically prepared food. They suddenly stopped growing.

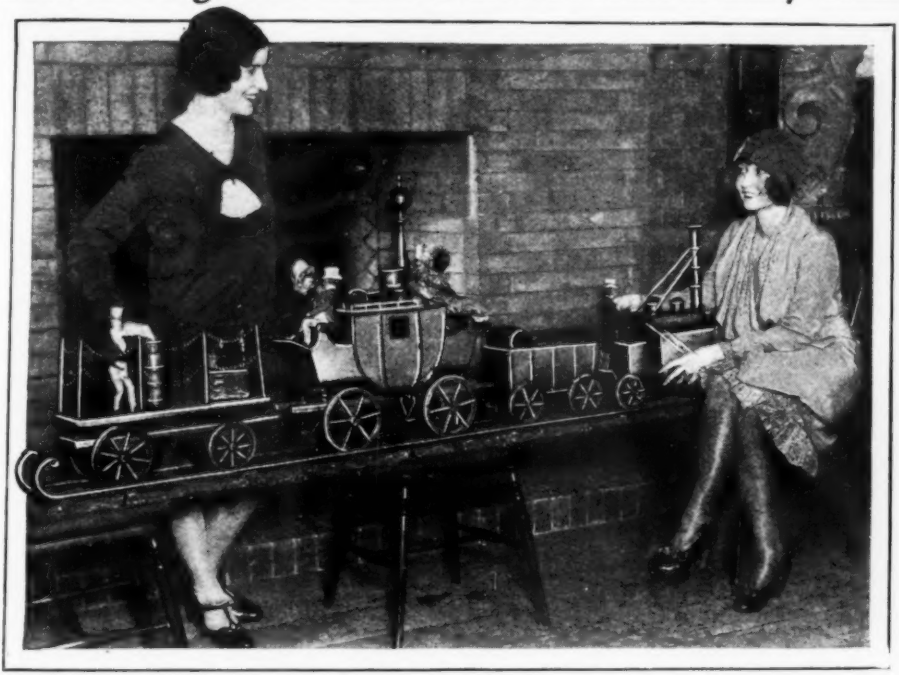
Go Back to Use of Sand-Timers

FIRMS in England are going back to the days when sand-clocks were used to calculate time. Sand-timers are being installed on telephones in order that calls may not exceed the limit of 3 minutes.

A phone equipped with one of these timers is shown being used in the photo below. It will be of value when long distance calls are made. The device is very similar to that used by housewives to determine the length of time an egg should boil.

Girl is using phone equipped with a sand-timer.

Hotel Dining Room Exhibits Clever Model of Early Train



MINIATURE models of cars comprising one of the first trains, decorate the "Four George's Room" on the roof of the Hotel Sherman, Chicago, Ill.

The models were made by Tony Sarg, famous for his marionettes and artistic ability. They were completed a number of years ago and have since been a part of the unique room.

Containing passengers, the train is mounted on its track about to leave the station. In addition to the tender, one passenger coach and one baggage car make up the load the engine is pulling.

May Reid and Mildred Melrose are shown in the photo above admiring the train.

Machine Builds up Pressures

TREMENDOUS pressures equivalent to the weight of water at the bottom of a sea 250 miles deep have been produced artificially in a machine perfected in the laboratories of Harvard University. When subjected to pressures of 60,000 pounds per square inch, paraffin became as rigid as steel, and rubber, submitted to a similar squeezing, turned hard enough to be used as a die in shaping steel.

Seize Smugglers' Trick Truck

RUM-RUNNERS bringing liquor to the United States from Mexico in a specially constructed truck were "nipped in the bud" recently by Federal officers. The truck was built with a cleverly hidden false bottom which concealed a large capacity tank, invisible to all except the sharpest-eyed. The mechanical ingenuity of the device, however, failed to win the favor of government agents.

150 gallons of liquor were hidden in this truck.

Planes Flocked Like Birds on Flight Bridge of Carrier

Blocks fitted under the wheels secure these planes.

LIKE gulls huddled on a beach! That's the way spectators of recent American Naval maneuvers in the Panama Bay described the U. S. S. *Saratoga*, giant Navy airplane carrier, as it took part in the exercises with a large number of planes on its flight bridge.

Airplanes played a leading role in the maneuvers in which the American fleet was divided into the "blue" Atlantic, defending the Panama Canal, and the "black" Pacific, attacking. The "blue" fleet was declared victorious over the "black."

The *Saratoga* is a sister ship to the U. S. S. *Lexington*. They are the largest airplane carriers in the world.

Boat to Help Planes in Channel

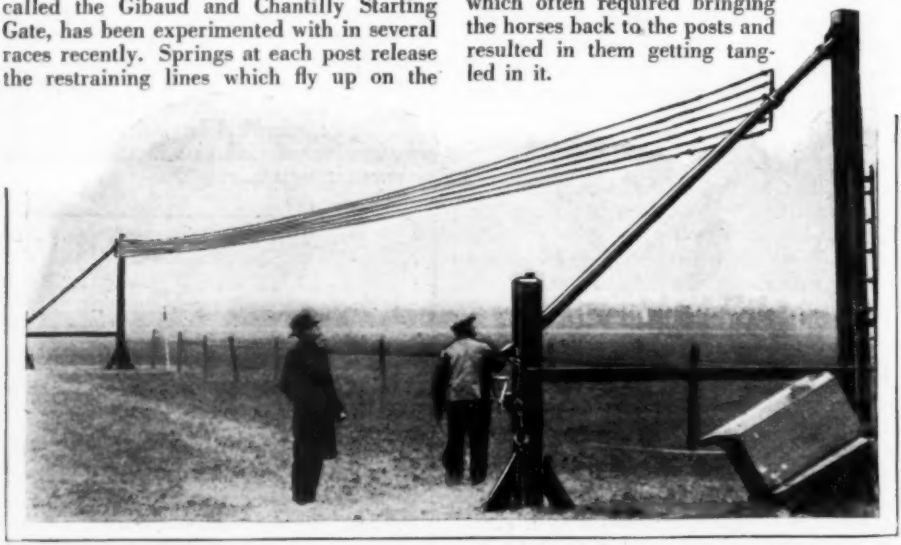
A LIFEBOAT designed to be the largest and fastest in the world was recently built in England to be stationed at Dover to help airplanes forced down in the English Channel.

Fight Boll Weevil From the Air

THE arch enemy ot cotton fields is now forced to contend with modern invention. For years the South has been waging more or less unsuccessful wars against the hardy little insect, the boll weevil. Today airplanes reap destruction at great speed, spraying poisonous smoke over the plants.

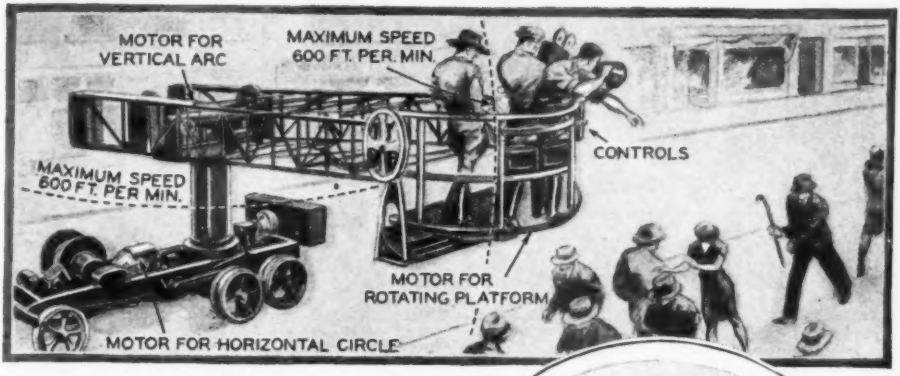
New Type of Barrier Lines Are Shot Into Air to Start Horseraces

"SPRING the barrier" is the new command to start race horses on the track at Newmarket, England. The new barrier, called the Gibaud and Chantilly Starting Gate, has been experimented with in several races recently. Springs at each post release the restraining lines which fly up on the piping. In all of the races in which the device was used the horses got off to a better start than with a single strand barrier, which often required bringing the horses back to the posts and resulted in them getting tangled in it.



The spring releasing this six-strand barrier is operated by the crank shown on post in foreground.

Movie Crane Gets Closeup 'Shots' From Difficult Angles


MOTOR FOR VERTICAL ARC
MAXIMUM SPEED 600 FT. PER MIN.
CONTROLS
MAXIMUM SPEED 600 FT. PER MIN.
MOTOR FOR ROTATING PLATFORM
MOTOR FOR HORIZONTAL CIRCLE

The camera platform of this huge movie crane has a capacity of 2,500 pounds. The crane is large enough to accommodate three cameramen and the director.

WHIRLING in a complete revolution at the rate of 600 feet a minute, this giant movie crane, at Universal City, California, permits all manner of trick shots. Built at a cost of $60,000, it is silent in operation and can therefore be used in making talking pictures. It is run by electricity.

The boom, or swinging portion of the crane, has a reach of 25 feet and is offset by a counter balance. This boom can be quickly moved in a vertical or horizontal plane at will. Its maximum height is 37 feet, counting the 12 foot base.

The crane is operated from the camera platform at the end of the boom. The platform is set on sprockets and can be whirled at a high rate of speed. By moving the truck on which the crane is mounted, the camera eye is given quick shifts around sets without changing scenes. The six-wheel truck base weighs 24,000 lbs., and the whole crane weighs 80,000 lbs.

Tune up the old radio set and get in on the baseball broadcasts—the season's on!

Edited by CHARLES MAGEE ADAMS

An "old timer" in the radio world, Charles Magee Adams, has won an enviable national reputation as an expert in his field. In this department, which is a regular monthly feature of Modern Mechanics, he presents the latest news and kinks of interest to the country's radio fans. Watch for it every month!

Take Your Radio on Your Motor Camping Trip

WITH the advent of summer, the thoughts of many are turning eagerly vacation-ward. For a goodly proportion of car owners this means anticipation of a long interesting motor trip, with the added pleasure of camping en route. To the radio contingent the attractive prospect of such an expedition may be tinged with regret at leaving behind the trusty receiver and the programs it brings nightly. But that need not be the case.

It is comparatively simple to take along a radio on an automobile camping trip and extract from it as much pleasure as at home. Not an a. c. receiver, to be sure. Current for its proper operation is not available in every shady nook so delightful for a camp site. However, the automobile makes a battery set quite convenient and practical. Its starting battery supplies an ample source of A power. The weight of dry Bs is no obstacle, and installation of the whole outfit is a problem against which fans will delight to pit their ingenuity.

This article is intended to offer some general suggestions regarding such an installation. They must needs be general since the conditions encountered vary so widely that no two cases are alike. But the suggestions to be offered should prove helpful in meeting individual problems.

At the risk of smothering a rosy hope, let it be said at the outset that the operation of a receiver while the car is in motion is usually not practicable. Interference caused by the ignition system is prohibitive without elaborate shielding. Added to this, there is the annoyance of microphonic tubes and vibration of condenser plates. Accordingly, the fan will have to be content with reception only during stops, which is what most wish anyhow.

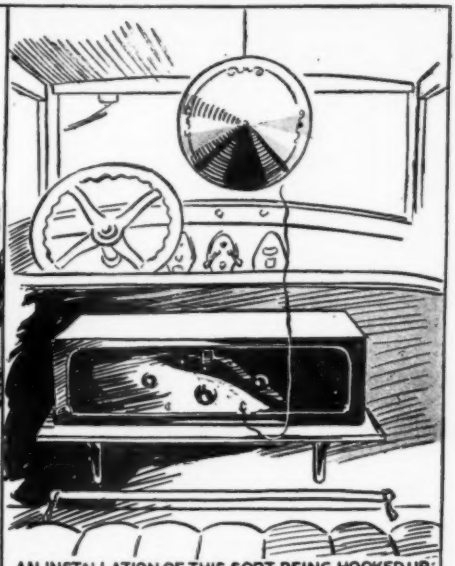
First—regarding the receiver. Any good battery set will do. Preferably it should have two or three stages of r. f. amplification, because of the aerial and ground limitations. Also, it should be as compact as possible. If one is being purchased, a five- or six-tube job of the type turned out in the last two or three years will be just the thing, and a used specimen can be picked up at a very modest price.

Second—the ground and aerial. For the former, the car frame is convenient and surprisingly satisfactory. But care should be taken to see that a clean tight contact with bare metal is made. If good DX is desired, a pipe can be carried and driven into moist earth, or a length of wire or a zinc plate immersed in running water.

The type of aerial used will depend entirely on conditions and the fan's choice. The simplest form consists of five or six turns of insulated wire (No. 14 r. c. pre-

These Sketch Suggestions Show Radio Hook-ups in the Summer Camp

THIS SIMPLE AERIAL, CONSISTING OF A FEW TURNS OF NO. 14 RUBBER-COVERED WIRE WRAPPED AROUND THE TOP, WILL ANSWER NICELY FOR THE RADIO CARRIED ON THE MOTOR CAMPING TRIP.



AN INSTALLATION OF THIS SORT, BEING HOOKED UP PERMANENTLY, PERMITS THE TOURIST TO RECEIVE RADIO PROGRAMS WHEREVER HE STOPS WITHOUT ANY DELAY FOR CONNECTIONS.

IF THE RADIO CANNOT BE INSTALLED CONVENIENTLY IN THE CAR, IT CAN BE CARRIED PACKED DURING THE DAY AND SET UP AT NIGHT IN CAMP, DRAWING ITS POWER FROM CAR BATTERIES.

FOR DISTANCE RECEPTION A GOOD GROUND IS ESSENTIAL, AND ONE ON THE BEST AVAILABLE TO THE MOTOR CAMPER IS A ZINC PLATE IMMERSED IN RUNNING WATER.

These hints for hooking up your radio to your motor car will enable you to derive much entertainment from your set in the tourist camp this summer. If you can find room, you'll want to take your set along on that long trip.

ferred) wrapped around the car's top, with a half inch or inch between turns. If the top is of metal, the wire should be outside, while if it is of wood and fabric the wire may be inside.

A better aerial, though one not so convenient, can be made by stringing up the usual length of wire between two trees (provided they grow where needed). Failing this, 50 or 100 feet of insulated wire can simply be laid out in a straight line on the ground and used as the aerial. Good results can be obtained, too, by driving a nail into a tree and connecting the aerial lead to this.

Mounting the receiver presents a nice little problem. If possible, it is desirable to have it installed within the car permanently. A shelf at the rear of the front seat is excellent provided that can be managed.

The loudspeaker deserves more than passing attention. It is not recommended that an open cone be used. This type is quite vulnerable to the damage inevitable in motor travel. An enclosed cone is preferable, provided it is small enough. A horn is still less likely to be damaged but has the disadvantage of being awkwardly large, when space is an important matter. A solution of the difficulty lies in rigging up a speaker from a standard unit, with a home-made horn of proper size and shape. This can be made of cardboard and to fit into the available space.

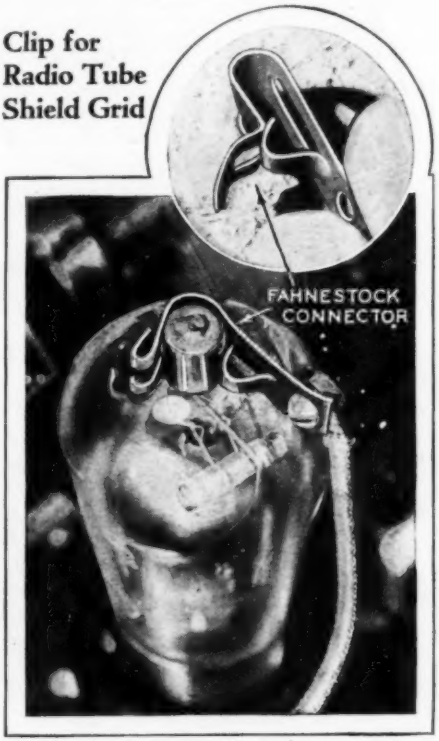
If the receiver is carried packed and set up at night, a simple and effective means of battery connection is the cable and plug arrangement. The cable is connected to the receiver posts, and the various battery leads brought to the terminal plate, which can be mounted at any convenient point. All connections can then be made merely by slipping the plug attached to the cable over the pins on this terminal plate.

The logical place to carry B batteries is the tool box or compartment under the rear deck. Care must be taken, however, to wedge them tightly in place to prevent jolting about and breaking connections. Also, they must not be short-circuited by tools or the metal compartment walls. A good safeguard against this is covering the tops of the batteries with heavy paper or a burlap bag.

The fan need have no fear that the use of a receiver at night will drain the starting battery dangerously. The amount of current consumed by a five- or six-tube set is small in comparison with that drawn by a starter, and with the long steady charge of the day's driving the battery should be kept in tip-top condition notwithstanding several hours' radio use each night.

Altogether, the fan can expect real fun from devising a radio installation for his automobile camp along the lines suggested.

Clip for Radio Tube Shield Grid



A SATISFACTORY clip for fastening the grid lead to the cap of a shield grid tube is easily made from a Fahnestock connector, as shown in the above photo. In converting the connector for its new job, the curved portion is slightly straightened so that it will fit snugly over the tube cap, and the projecting end, being longer than necessary, is bent back. The lead wire is connected by means of short machine screws, or is merely soldered. The necessary alterations are clearly shown in the picture.

Can Detect "Poison Pen" Writers With This Apparatus

TESTIMONY of scientists has practically decided any number of murder trials in the past, either in favor of or against the defendant. With use of this apparatus shown at right, the part played by experts on identification of typewritten documents will be even greater in the future.

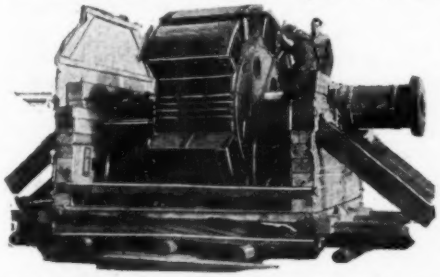
Dr. Wilmar Souder, of the Bureau of Standards, Washington, D. C., is shown making a microscopic study of type peculiarities. Impressions are greatly magnified by the device, and experts are able to ascertain whether or not a line of typewriting was made on a certain machine.

It is thus possible to identify a typewriter on which any material has been written by making a close examination of the writing. Defendants alleged to have written an incriminating note could therefore be convicted by the experts' findings.

Dr. Souder examining typewritten documents.

Ship Largest Rotors to New York

TWO huge rotors weighing 113 tons each and believed to be the largest electrical



equipment in the world were recently unloaded in New York City after a 24-hour trip from South Albany, N. Y. They are being used in Waterside Generating stations.

Earth Has Tail, Says Astronomer

THAT the earth has a tail like that of a comet is the startling conclusion reached by Dr. Carl Stormer, prominent Norwegian astronomer, after an extensive study of the northern lights. These brilliant hues are sometimes seen 1,000 or 1,500 miles above the ground.

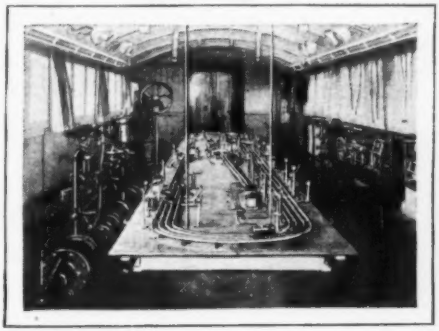
Dr. Stormer recently discovered radio echoes, which are believed to be due to waves which leave the earth and are reflected back from clouds of electrons. The only probable explanation of these high auroras, Dr. Stormer believes, is that sunlight shining on the earth, drives off billions of gas atoms from the upper layers of air.

Steam Will Light a Cigarette

LIGHTING a cigarette with steam was recently demonstrated before the Royal Institution of London. High pressure steam hot enough to set fire to shavings and cigarettes was produced by the experimenter, who explained that steam that escapes from a tea kettle is not strictly speaking real steam. By the time it emerges, it has condensed into tiny drops of liquid and has ceased to be steam. Real steam is invisible gas.

Learn Train Control From Models

TRAINING employes in the operation of train control is done on this special instruction car of the Orleans Railway of France, shown below. Model trains, tracks, signals and other equipment enable men in training to solve many problems.



The platform holding this model train raises to the ceiling when not in use for instruction.

Outboard Motor Brings Seaplane to Landing in Dense Fog

Outboard motor carried in seaplane for emergency landings.

A NEW wrinkle in aviation was recently demonstrated by Pilot Verne C. Gorst, of the Seattle Air Company, and Miss Amelia Uhrich, shown at left.

Carrying an outboard motor in their seaplane for use in forced landings, they put it to a new use when coming down in a dense fog. The roar of the plane's motors drowned out the sound of warning fog horns. They therefore attached the outboard and "taxied" the plane safely to a landing.

The blasts of the horns could easily be distinguished, and chances of being run down by invisible ships were eliminated.

Plane May Cross Ocean Again

THE Fokker airplane, Friendship, in which Amelia Earhart, Wilmer Stultz, and Lou Gordon made their trans-Atlantic flight, was recently sold to a group of Argentine aviators by its owner, Donald Woodward.

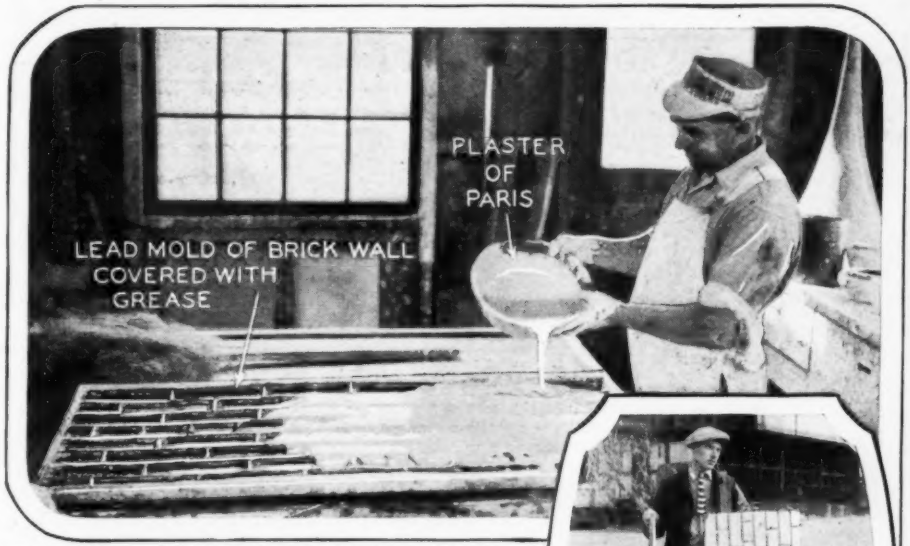
The purchasers expect to fly it on another west-to-east passage, this time across the South Atlantic from Brazil to Spain. Mr. Woodward, wealthy aviation enthusiast and founder of the school bearing his name, sold the machine for $50,000, which is less than he paid for it.

This Amphibian Row-Mobile Travels Equally Well on Land or Water

This combination boat and automobile is fitted with air and water-tight compartments to prevent sinking in water. Note the vanes on the rear wheel which act as propeller of the queer craft.

LAND or water—it makes no difference to the passengers of this combination boat and automobile. The "amphibile" is propelled by the rowing motion of the occupants. The front wheels are used to steer both on land and in water.

Making Movie Sets from Plaster



Slabs of plaster of Paris, molded in the shape of bricks, are used by movie producers in constructing sets in which brick buildings appear. As shown above, the molds are made of lead and covered with grease so that when the plaster hardens the slab can easily be removed. The workman at the right is holding two completed plaster slabs; the side view shows how thin these slabs are.

The above still from a recent movie production shows a brick building which has been made from plaster slabs as described above. The molded brick forms are tacked to wooden uprights, the white plaster painted the desired color, and the movie spectators never suspect that the bricks weren't laid by hand in the usual fashion. Note how solid and substantial appearing this plaster building is.

AMATEUR CAMERAMAN

With the camera mounted alongside the racing car, intrepid cameramen obtain difficult shots.

Edited by WALTER D. KERST

Mr. Kerst is an associate member of the Society of Motion Picture Engineers and a nationally known expert on the technical aspect of movie making. His professional production experience qualifies him to advise the amateur on securing best results from his home movie camera, and in this department every month, Mr. Kerst gives the amateur the advantage of his wide training.

Make Yourself a Camera Truck Like Professionals Use

THE accompanying illustration shows a unit of the Famous Players Lasky Corporation at work on a desert location and a careful examination of the photo will point out to the amateur the care necessary if good results are to be obtained.

An analysis of the picture shows the cameras mounted on bases which are supported by a cylindrical stanchion in the center about which the cameras may be raised or lowered or revolved in any position. For the small amateur cameras it is not necessary to go to such elaborate pains in building a device like this. The auto, which is used to make a moving camera shot, can be supplanted in amateur camera work by a low four-wheel (rubber tires are necessary) wagon made of small bicycle wheels and pieces of one by six lumber. The truck need not be more than 18 inches high but it should be large enough and strong enough to carry one or two cameras on their supports and at least three men, two cameramen and an assistant. The stand for the cameras, as shown in the photo, may be made from odds and ends of material that accumulate in most all homes. An iron pipe can be used for the center stanchion and then a wood or metal support can be rigged up to hold one or two cameras, as desired.

This picture of a Famous Players-Lasky crew on location shows a type of camera truck much favored by professionals. Note swivel mounting.

One other interesting feature of the photo is the large umbrella shading the cameras. This is most important if successful film is to be shot, particularly on locations where the sun is glaring. In addition to the mask boxes seen on the cameras the umbrella prevents all stray rays of light from reaching the lens.

Focus and Lighting Help Make Hazy Background Shots

IN THE photo at the right will be found an excellent example of the third dimensional effect secured by proper lighting and focusing of the lens. Note how sharply the figures stand out against the slightly diffused background. The method of achieving this is to focus sharply on the principal figures and use the lens at its widest opening when shooting. The figures should be as far as possible in front of the background, for if the sharply focused object is practically in the same plane as the background, both will register on the film with equal sharpness, losing the illusion of depth.

Depth of focus is splendidly illustrated by this picture. The wider open a lens is used, the less the depth in the picture, and vice versa. If a certain object is focused sharply at, say, 3 feet, and the diaphragm stop selected is f 3.5 then everything nearer to the lens than 2.4 feet and everything further than a point 4 feet from the lens will be out of focus. This gives us a "depth of field" of 2.5 feet in which everything will be as sharp as the principal object. Knowing this, if we wish to secure this third dimensional effect, it behooves us to keep our principal object enough distance in front of the background so that the background will not be in this "depth of field" zone. But as we stop down our lens, say from f 3.5 to f 11, the 2.5 foot depth of field increases and at f 11 it becomes a field with a depth of 14.2 feet. That is, everything within a distance 1.7 feet from the lens to 15.9 feet from it will be in sharp focus.

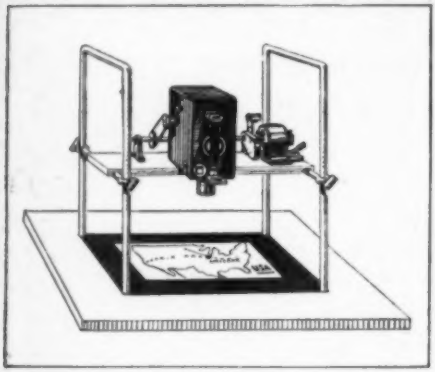
Careful focusing and lighting make the figures in this picture stand out sharply against the hazy background. Note the effect of depth obtained.

The depth of focus table illustrated has been calculated for a lens of one inch focal length, which is the standard lens for 16 mm. film. If you will copy this table on a card and carry it with you when you go "shooting," it will prove of real help in estimating your focus distance and giving exactly the effect you are striving for.

Distance Focused On	Diaphragm Apertures.										
	f 1.5	1.8	2	2.5	3.5	4	4.5	5.6	8	11	16
2 feet	1.8-2.1	1.8-2.2	1.8-2.2	1.8-2.3	1.7-2.4	1.7-2.5	1.7-2.6	1.6-2.8	1.5-3.3	1.3-4.4	1.1-10.7
3 "	2.7-3.3	2.7-3.4	2.6-3.5	2.5-3.6	2.4-4	2.3-4.2	2.3-4.4	2.1-4.9	1.9-7.1	1.7-15.9	1.4-inf.
4 "	3.4-4.6	3.4-4.8	3.3-4.9	3.3-5.4	3-6	2.9-6.5	2.8-7	2.6-8.4	2.3-17.3	2-inf.	1.6-inf.
6 "	4.9-7.6	4.8-8.1	4.6-8.4	4.4-9.3	4-12.1	3.8-142	3.6-171	3.3-285	2.8-inf	2.3-inf	1.8-inf.
8 "	6.2-112	5.9-122	5.7-129	5.4-153	4.8-244	4.5-396	4.3-59	3.9-inf	3.2-inf	2.6-inf.	2-inf.
10 "	7.3-156	7-17.5	6.7-192	6.2-25	5.4-625	5.1-inf.	4.8-inf	4.3-inf	3.4-inf	2.7-inf.	2-inf.
12 "	8.3-211	7.9-248	7.6-283	7-43	6-inf.	5.5-inf	5.1-inf	4.6-inf	3.6-inf	2.9-inf	2.1-inf.
15 "	9.7-32.7	9.1-424	8.7-537	7.9-inf	6.6-inf	6.1-inf.	5.7-inf	5-inf.	3.9-inf	3.1-inf.	2.2-inf.
25 "	131-inf	12-inf.	113-inf	9.9-inf	8-inf.	7.3-inf.	6.7-inf	5.7-inf	4.3-inf	3.2-inf.	2.3-inf.

This depth of focus table is arranged for a one-inch lens as usually found on amateur cameras.

MAKING ANIMATED PICTURES



THE above drawing shows a fairly elaborate contrivance for making animated pictures which can be made as is by the ambitious amateur, or modified as may be desired for the sake of simplicity. Essentially, the device consists of a standard upon which a camera can be mounted, with arrangements for moving the camera mount up and down or the camera itself from side to side as the occasion may require. In the picture the camera is photographing an animated map—that is, a dotted line is being drawn across the continent in motion, in this instance. Individual dots are inked in by hand, a frame or two of film is exposed, and the process repeated until the picture is finished. The mount is merely a convenience for permitting proper focusing and insuring that the camera will remain steady at all times. The device is also useful for making titles.

TALKIES FOR LECTURERS

THAT sound and dialog pictures are with us to stay for some time, no one will deny. They have swept the country by storm. The publicity given the talking films by the professional producing concerns, has, however, eclipsed other uses to which the talking movie can be put. In connection with industrial and educational films, the talking movie is ideal. In the past lecturers, with either lantern slides or movies, delivered their lectures in person while the films or slides were shown. Now reels of films can be made up for an illustrated lecture, and the lecturer, in a recording laboratory will have his lecture photographed on film. The lecture film is combined with the reels of pictures and as many prints as desired can be made and shipped to all parts of the country or world. Simultaneously, in a hundred different cities, Professor Jeremiah Potts can deliver his famous lecture on the Life of the Amoeba without his having to set foot outside of his comfortable library. This is just one of the many uses of the talking film and no doubt the future will show many new applications of this miracle of the century.

Asked and Answered

Are you having any difficulties with your picture taking or projection machine? If you are, write to Walter D. Kerst, Modern Mechanics magazine, Robbinsdale, Minn., and your questions will be adequately answered.

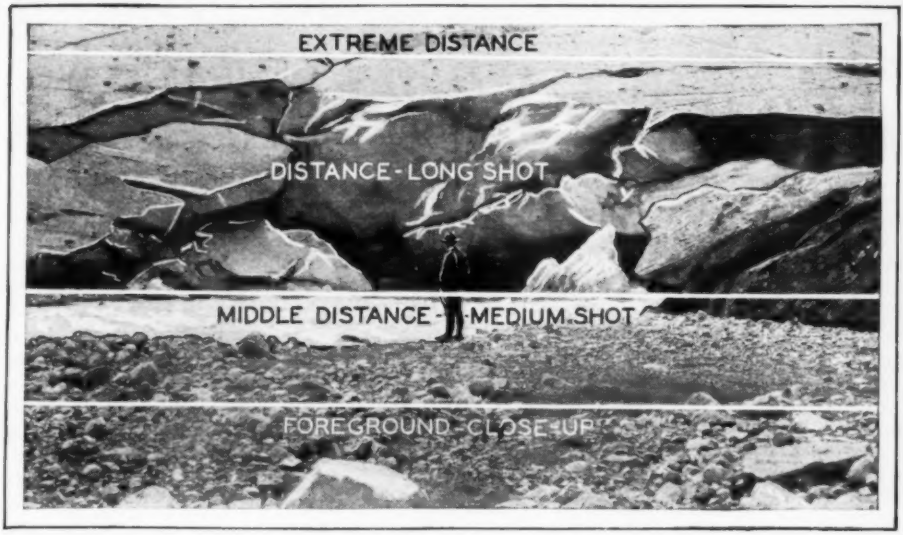
J. L. T. asks: "How can I get pictures in natural color without having to secure the Kodacolor or Vitacolor attachments and film for my camera?"

Answer: This can be accomplished by dye-toning the finished film with three or more suitable colors. This is not at all difficult to do. A small space, a few photographic trays, and the necessary chemicals and dyes are about all that are needed for the work. The method is explicitly explained in a volume titled "Tinting and Toning Positive Motion Picture Film," published by the Eastman Kodak Company, at Rochester, New York. The cost of the volume is $2.50 and it is well worth the price. It can be secured only direct from the Eastman Kodak Company at Rochester.

M. A. B. asks: "When projecting my pictures the lower loop of film becomes lost and the pictures race by on the screen at great speed. Is there any way whereby I can re-engage the lower loop with the sprocket teeth without stopping the projector and re-threading?"

Answer: The reason your lower loop is lost is because of broken sprocket holes on the side of the film in which the pull-down claw engages. I would suggest that before running a reel of film you examine it for broken or torn sprocket holes. Cut these out before projection. If the loop is lost, insert your finger underneath the lower sprocket and exert a slight pressure downwards on the film while the projector is running. This will cause the film to re-engage with the sprocket teeth.

Photo Gives Hints on Determining Focus of "Shots"



THIS photo illustrates the various planes of a picture in which the close-up, medium shot and long shot would be found. The close-up is always found in the immediate foreground, up to 7 or 8 feet from the lens. The "medium" shot is found in the middle distance, and the shot of the figure near the stream is a medium shot. On the other side of the stream is the distance, or the area in which the long shot is made, and further back than this is the extreme long shot. This will help to clarify the amateur's discussion of various types of shots made. In connection with the exposure, it is a general rule that the nearer the objects are to the lens, the greater the exposure. In this particular shot the main interest centers in the ice crevasses on the opposite side of the stream, and hence the exposure should be calculated for this particular part of the scene. If this is done, the other elements will take care of themselves as far as exposure is concerned.

JULY EXPOSURES

THE month of July, with its intense sun, calls generally for smaller lens openings on nearly all shots. For sea scenes, in which sky and water and perhaps a distant ship on the horizon are the only objects, a stop of f.16 with a 2 or 4 times filter should be used with panchromatic film. For other water shots, such as lakes, rivers, etc., stop f.11, with a filter if no intense shadows are included and f.8 or f.11 without a filter if the scene is on a river or the shore of a lake shaded by trees. Long shots on land call for one stop larger than the above under similar conditions. Medium shots in the open field require a diaphragm opening of f.8 or f.11. If heavy shadow lies in the foreground open one stop wider. Close-ups or shots at 4 to 8 feet call for a diaphragm stop of f.5.6 or f.8. Extreme close-ups from 2 to 4 feet should be shot at f.3.5 or f.4.5.

The above figures will serve as a general guide as many other factors enter into the exposure of any given scene. This can be taken into consideration by the amateur when making the particular scene. Remember to use panchromatic film on all landscapes in July, as the foliage will register much better than on ordinary film. Use reflectors to take advantage of the intense July sunlight and to enable you to stop down the lens as far as possible so as to get the maximum sharpness.

Use panchromatic film for night fireworks displays, if in black and white, and better still have your camera equipped for Kodacolor or Vitacolor natural color film so that you can record the exquisite pinks, yellows and reds of pyrotechnic displays.

Coo-Coo? Judge for Yourself

Can you originate a Coo Coo Contraption? If you are a Coo Coo Inventor, your ideas may earn you a prize check from Modern Mechanics! These Coo Coo's below cashed in!

ENTRIES in MODERN MECHANICS' Coo Coo Contraptions contests continue to grow better and more numerous each month. If corporations have not already been formed to manufacture some of the devices that have been concocted by coo coo inventors, the Coo Coo Editor is seriously thinking of resigning to promote such a scheme among wealthy capitalists. Huge profits could be reaped, he believes, from the sale of some of the apparatus that has originated in the minds of some of the contestants.

Winners of Contest No. 6 were finally selected this month after a great deal of consultation and weighing of technical points involved.

Larry Reed, of Stanton, Neb., was awarded first prize of $25 in cash for his contraption to provide electric power for a summer home by the sea.

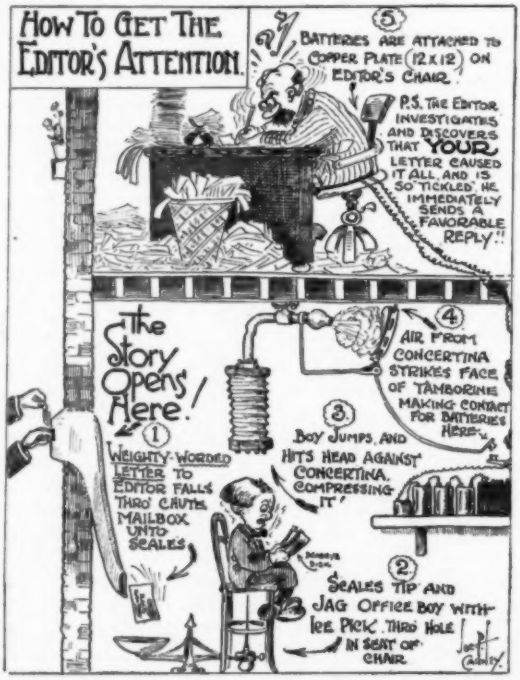
This machine would be ideal for summer resorts. Cigar smoke puffed into the whale's face makes him sick and he spouts forth a stream of water that falls into a large funnel. Emerging from this, it runs over a power wheel which turns a generator. An arm on the generator opens and closes a pair of bellows. This keeps the cigar lighted and blows its smoke at the whale, making the operation continuous.

Had Joseph Carney, 512 W. 50th St., New York City, employed the means of getting the Editor's attention that he has set down as an entry, he might still have won second prize of $10 cash—and he might not. As it was, he got attention without the "shocking plan" he had in mind.

Winners of the five $3 prizes were: Walter McKnight, Philadelphia, Penn.; Charles Alberts, Sioux Falls, S. D.; T. Moore, Detroit, Michigan; Charles Hardy, Los Angeles, Calif., and Mart Hayes, Atlanta, Georgia.

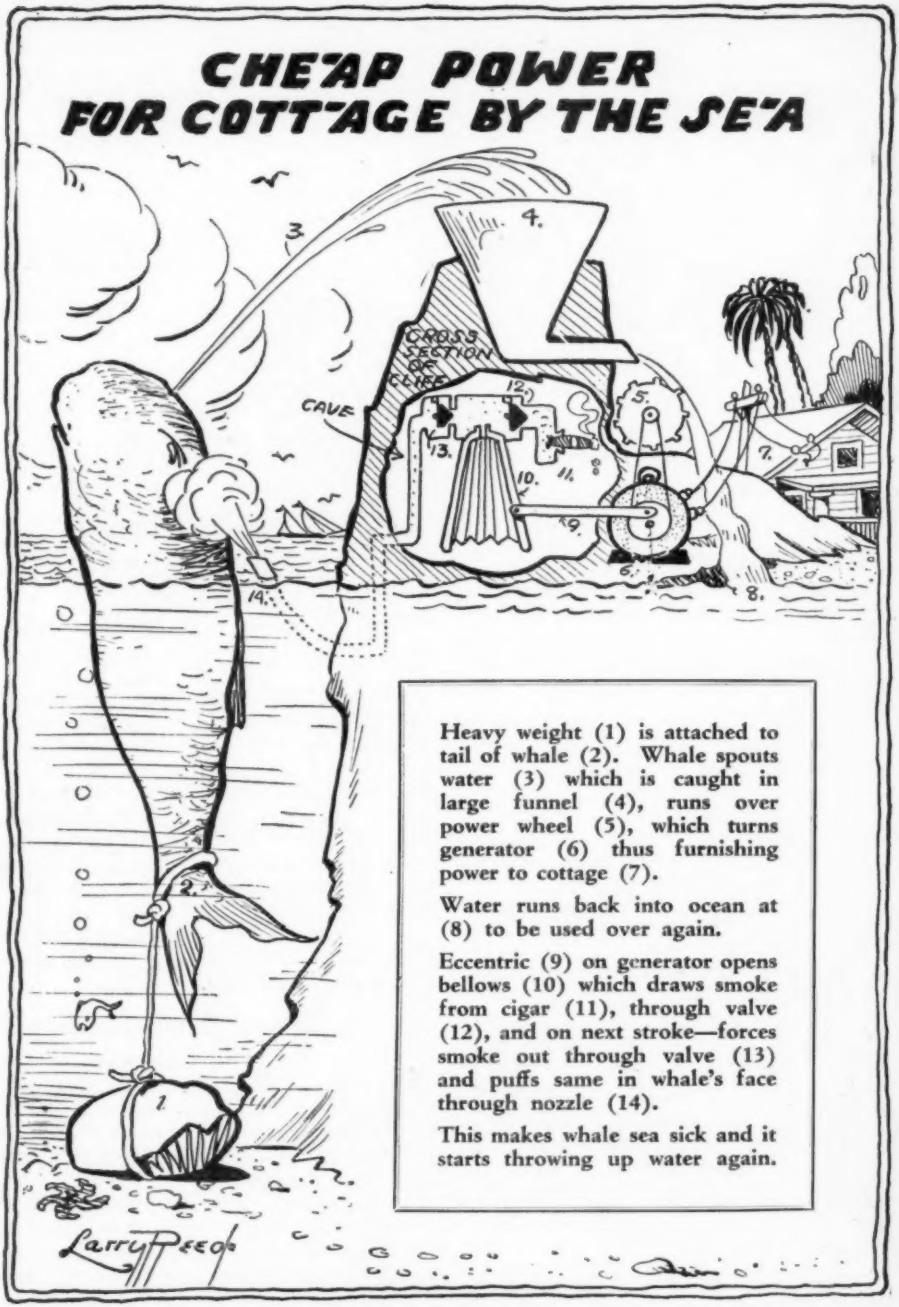
Contest No. 9 will close Aug. 1. All entries received after that date will be entered in Contest No. 10. Prizes will total $50.00. First place will be awarded $25; second, $10, and five prizes of $3 each. No manuscripts will be returned. The contest is open to everyone except employes of Fawcett Publications, Inc. You do not have to be a subscriber of MODERN MECHANICS to enter this contest.

Although the contraptions of both first and second prize winners were well enough drawn to publish without redrawing, this is not necessary to win a prize.


HOW TO GET THE EDITOR'S ATTENTION
5
BATTERIES ARE ATTACHED TO COPPER PLATE (12 x 12) ON EDITOR'S CHAIR
P.S. THE EDITOR INVESTIGATES AND DISCOVERS THAT YOUR LETTER CAUSED IT ALL AND IS SO TICKLED HE IMMEDIATELY SENDS A FAVORABLE REPLY!!
THE STORY OPENS HERE!
4
AIR FROM CONCERTINA STRIKES FACE OF TAMBORINE MAKING CONTACT FOR BATTERIES HERE
3
BOY JUMPS AND HITS HEAD AGAINST CONCERTINA, COMPRESSING IT
1
WEIGHTY-WORDED LETTER TO EDITOR FALLS THRO' CHUTE MAILBOX UNTO SCALES
2
SCALES TIP AND JAG OFFICE BOY WITH ICE PICK. THRO HOLE IN SEAT OF CHAIR

Joseph Carney, New York City, won second prize of $10 cash for his idea of How to Get the Editor's Attention.

Coo Coo Inventors Win $50 in Cash Prizes Each Month



Heavy weight (1) is attached to tail of whale (2). Whale spouts water (3) which is caught in large funnel (4), runs over power wheel (5), which turns generator (6) thus furnishing power to cottage (7).

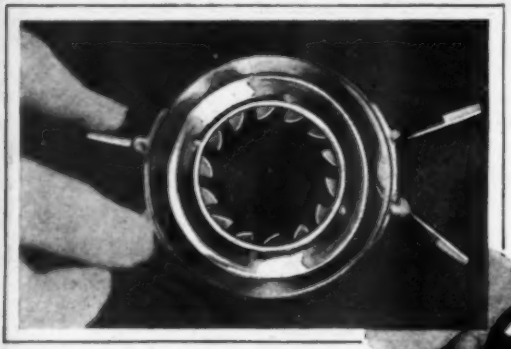
Water runs back into ocean at (8) to be used over again.

Eccentric (9) on generator opens bellows (10) which draws smoke from cigar (11), through valve (12), and on next stroke—forces smoke out through valve (13) and puffs same in whale's face through nozzle (14).

This makes whale sea sick and it starts throwing up water again.

Larry Reed, Stanton, Nebraska, won first prize of $25 with his plans to generate electric power.

No Need to Spill Egg Nor Burn Fingers with This Device

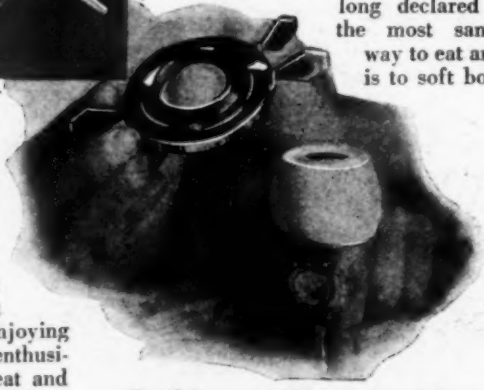


The sharp teeth of this novel egg shell clipper make a sharp cut and are operated by squeezing the levers shown.

PARISIAN chefs are famous the world over for their dainty pastries and tasty dishes. One now comes forward with an invention to prepare boiled eggs for eating.

This unique clipper, shown at left, is equipped with a little circular saw which snips the dome of an egg neatly and quickly.

Doctors and health experts have long declared that the most sanitary way to eat an egg is to soft boil it.



Take Up Motorcycling

SEVERAL years ago few women would have cared to take up motorcycle riding either as a sport or a means of transportation. Yet today many girls and women are enjoying their daily rides and are extremely enthusiastic about them. A new type of seat and shock absorbers makes riding as smooth as occupying a Pullman car or the back seat of a limousine.

Air-cushioned seat makes riding over rough roads easy.

Building 40-Passenger Planes

ORDERS were recently placed by the British government for several mammoth airplanes with a 40-passenger capacity for the England-India air route. They are quadruple-motored Handley-Page machines. A new design is being followed, with two wing engines on the lower planes and two on the upper. The body slung under the wings affords an unimpeded view and reduces much of the noise.

The planes are being fitted with Handley-Page slot aileron controls, practically eliminating stalls in the air.

Chile Craters Spout Sulphur

THIRTY years of exploration of the deserts of Chile, in South America, have rewarded Don Juan M. Goikovic, a Montenegrin prospector, with discovery of what is believed to be the richest deposit of pure sulphur in the world.

Estimates have placed the quantity found exceeding 200,000,000 tons. It is lodged in the slopes of six volcanoes. From the mouths of the craters, about 95 per cent pure sulphur continues to flow, according to the explorer.

Clear Mountain Roads of Snow for Tourists

PREPARING for the influx of summer tourists, this giant steam shovel, shown at right, is clearing away tons of snow from a mountain road in Ranier National Park.

Summer visitors will no doubt appreciate getting away from the heat and humidity of lower altitudes, but whether or not they would enjoy being snowbound in mountain wilderness, where thousands of tons of snow and ice remain the year around, is a matter of personal opinion.

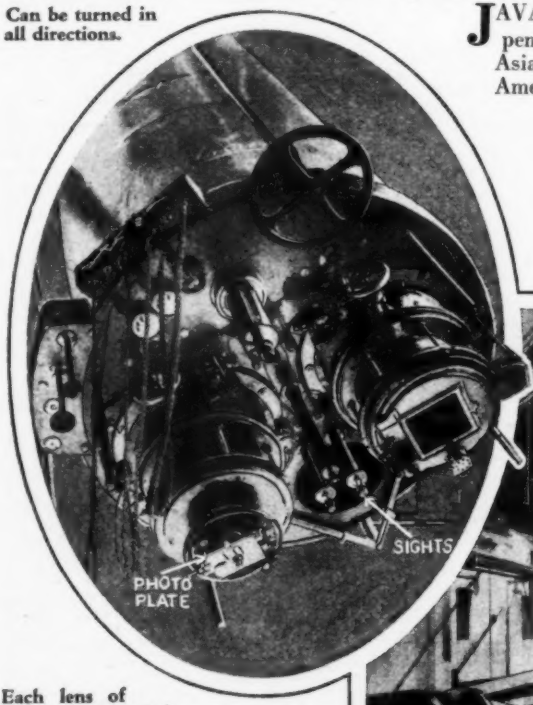
Park officials are not depending on personal opinions, however, and this steam shovel was therefore used to clear the road.

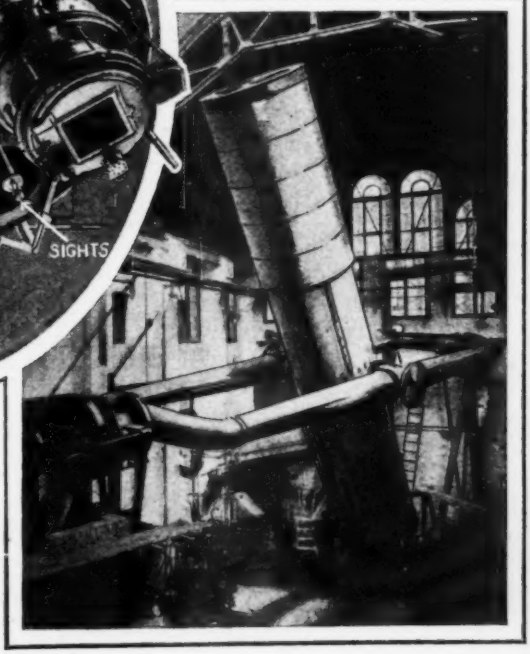
Steam shovel lifts a cubic yard of mountain snow with each sweep of its huge scoop. Caterpillar treads, with ice-spikes protruding several inches, make it possible to move the shovel about the slippery gullies with comparative ease.

Peer Millions of Miles Into Space With This Powerful Telescope

JAVA, located on the tip of the Malay peninsula off the coast of southeastern Asia, seems to residents of the North American continent to be isolated from modern science and invention. But Javanese are making observations daily with a huge telescope that rivals any in the world. With its aid, celestial objects millions of miles away can be seen clearly day or night.

Can be turned in all directions.





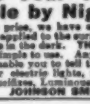
Each lens of this immense telescope measures 600 millimeters in diameter and consists of the most perfect glass it is possible to construct. It is a Zeiss double-refractor and is one of the most powerful in the world. Both telescopes are encased in the large tube. One is for visual observation and the other for astro-photographical purposes. The apparatus weighs about 28,000 pounds.

LUMINOUS PAINT

Make Your Watches, Clocks, Etc., Visible by Night The very latest discovery in the scientific world. Hitherto, practically unobtainable at any exorbitant price, we have at last succeeded in producing this remarkable LUMINOUS PAINT, which, applied to the surface of any article, emits rays of white light, rendering it perfectly visible in the dark. **THE DARKER THE NIGHT THE MORE BRILLIANT IT SHINES.** Perfectly simple to use. Anyone—you can do it. A little applied to the dial of your watch or clock will enable you to tell the time by night. You can coat the push button or switch plates of your electric lights, match boxes, and innumerable articles to make your own Luminous Crucifixes, Luminous Rosaries, etc. Small bottle, **price 25c.** Larger size, 50c and $1 postpaid. JOHNSON SMITH & CO. Dept. 906, RACINE, WIS.

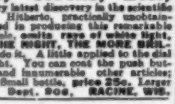
CIGARETTE MAKER

Roll your own and save money. Better and quicker; saves more than half. Use your favorite brand of tobacco. Neat, useful, handy. Pocket size, weighs ½ oz. Made entirely of metal, nickel plated. **25c, 3 for 60c** postpaid anywhere.



GOOD LUCK RING

Very striking, quaint and uncommon. Silver finish; skull and crossbones design, two brilliant, flashing gems sparkle out of the eyes. Said to bring good luck. **Only 25c ppd.**



Exploding Cigarettes

JUST LIKE ORDINARY CIGARETTES. BUT SUCH REAL STARTLERS! The box contains ten genuine cigarettes of excellent quality. They appear so real, but when each cigarette is about one-third smoked, the victim gets a very great surprise as it goes off with a loud BANG! A great mirth provoker yet entirely harmless. **Price 25c box.**

NOVELTY BADGES

Kissing Permit 10c *Carter Inspector 10c*

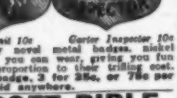
Two very novel metal badges, nickel plated, that you can wear, giving you fun out of all proportion to their trifling cost. 10c, **each badge, 3 for 25c, or 75c per doz. postpaid anywhere.**

SURPRISE MATCHES

More fun than fighting with your wife. Look just like ordinary matches. Put up in boxes just like regular Safety Matches. As the victim tries to light one he gets quite a surprise. **Price 10c per box, 3 boxes for 25c, 12 for 75 cents.**

MIDGET BIBLE

GREAT CURIOSITY Smallest Bible in the World. Size of a postage stamp. 240 Pages. Said to bring good luck to the owner. A genuine work of art. Must be seen to be appreciated. Make good money selling them to friends, church acquaintances, etc. **PRICE 15c, 3 for 40c, 12 for $1.39, 100 for $7.80.** Also obtainable in Leather Binding, with gold edges. **Price 90c each, 3 for $1.25, $4.80 per doz.** Magnifying Glass for use with Midget Bible **15c.**



STAR TOY MAKER

Greatest boys' book written. Tells how to make a Pinhole Camera, a Canoe, model Railroad, a Telephone, Boomerang, Telegraph Instrument, Box Kite, Talking Machine, Microscope, Electric Motor, Electric Door Bell, Water Wheel, Paddle Raft, a pair of Skis, a Dog Sled, Bird House, Rabbit Yard, etc. 64 pages. 150 illustrations. **PRICE 10c postpaid.**

STAGE MONEY

With a bunch of these bills, it is easy for each person of limited means to appear prosperous by flashing a roll of these bills at the proper time and peeling off a genuine bill or two from the outside of the roll, the effect created will be found to be all that can be desired. **Prices, postpaid: 40 Bills 20c, 120 for 50c, or $3.50 thousand postpaid.**

Wonderful X-Ray Tube

A wonderful little instrument producing optical illusions both surprising and startling. With it you can see what is apparently the bones of your fingers, the lead in a lead pencil, the interior opening in a pipe stem, and many other similar illusions. A mystery that up one has been able to satisfactorily explain. **Price 10c, 3 for 25c, 1 dozen 75c. Johnson Smith & Co.**

MAGIC NOSE FLUTE

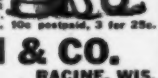
The Magic Nose Flute, or Harmonicon, is a unique and novel musical instrument that is played with nose and mouth combined. There is just a little knack in playing it which, when once acquired after a little practice, will enable you to produce very sweet music, that somewhat resembles a flute. There is no fingering, and once you have mastered it you can play all kinds of music with facility and ease. When played as an accompaniment to a piano or any other musical instrument, the effect is so charming as to be surprising.

Post Paid 10c

NOSE BLOWER

When some men blow their noses it sounds like a trombone. Now the *NOSE BLOWER* has come to torment us. It is a startler! It is ingeniously concealed in the handkerchief. Proceed to blow your nose and your friends will think they heard a steam engine or something. You can blame the hideous noise to your having a very bad cold and keep up the fun as long as you like. *PRICE 10c, 3 for 25c, or 75c doz. postpaid.*

Serpent's Eggs



Box contains 12 eggs. When lit with a match, each one gradually hatches itself into a snake several feet long, which writhes and twists about in a most life-like manner. **Price per box, 10c postpaid, 3 for 25c.**

JOHNSON SMITH & CO.

Dept. 906, RACINE, WIS.

A De Luxe Edition of our new 1929 CATALOG mailed on receipt of 25c. Handsome binding. Bigger and better than ever. Only book of its kind in existence. Nearly 600 pages of all the latest tricks in magic, the newest novelties, puzzles, games, sporting goods, rubber stamps, unusual and interesting books, curiosities in goods and plants, etc., unprocurable elsewhere. Remit by Coin, Money Order, Check or unused U. S., Canadian and Foreign Stamps for all articles listed above.

BLANK CARTRIDGE PISTOL

Protection against Burglars, Tramps, & Dogs **Special Offer** 1 Blank Cartridge Pistol, 100 Blank Cartridges & 1 550-page Novelty Catalog for **ONLY $1.50** The Lot Shipped by Express Only Cash With Order Only

Well made and effective, modelled on the latest type of Revolver; appearance alone is enough to scare a burglar. When loaded it may be as effective as a real revolver without danger to life. It takes standard .22 Cal. Blank Cartridges—obtainable everywhere. **Special cash with order offer:** 1 Superior quality Blank Cartridge Pistol, 100 Blank Cartridges, and our new $50 De Luxe Catalog of latest novelties; all for **ONLY $1.50.** Shipped by Express only. Cannot go by parcel post. Extra Blank Cartridges **50c per 100.** Special Holster (Cowboy Type) for pistol **50c.** No C. O. D. shipments.

LOOK 35¢ LOOK Wonderful Instrument.

Greatest thing yet. Nine separate articles in one. Everybody delighted with it. Odd, Curious and interesting. Lots of pleasure as well as very useful. It is a double Microscope for examining the wonders of nature. It is also an Opera Glass, a Stereoscope, a Burning Lens, a Reading Glass, a Telescope, a Compass, a pocket Mirror, and a Laryngoscope—for examining eye, ear, nose and throat. It is worth all the cost to locate even one painful cinder in the eye. Folds flat and fits the pocket. Something great—you need one. Don't miss it. Sent by mail. **Only 35c or 3 for $1.00**

JOHNSON SMITH & CO., DEPT. 906, RACINE, WIS.

INVISIBLE INK

The most confidential messages can be written with this ink, for the writing **makes no mark.** Cannot be seen unless you know the secret. Invaluable for many reasons. Keep your postals and other private memorandums away from prying eyes. Great fun for playing practical jokes. **Only 15c a Bottle; 3 for 40c.**

Rubber Chewing Gum

It is just like a regular package of chewing gum and looks so real that it fools everybody. Of course no one suspects it is not genuine until they start to chew it. There's a world of fun in this rubber chewing gum — 5 sticks to the package. **Price, 10c. Pkg. 3 for 25c; 12 for 75c postpaid.**

Johnson Smith & Co., Dept. 906 Racine, Wis.

Watch Charm Pistol $1.75

Exact reproduction of a real pistol; actually fires REAL BLANK CARTRIDGES of miniature size. Illustration is of actual size. 1¼ inches long, with ring at end for attaching to watch chain. Loads like a regular pistol. Pull the trigger and it goes off with a loud bang. Pistol is break open type; illustration shows position for loading. Made entirely of high grade steel, nickel plated, octagon barrel, handsomely engraved handles, complete in box with cleaning rod. **PRICE $1.75.** Also furnished with pearl handles, **$2.50. BLANK CARTRIDGES, 50c** per box of 25.

JOHNSON SMITH & CO., Dept. 906, RACINE, WIS.

MICROPHONE TRANSMITTER BUTTON

$1.00 Postpaid

You can easily make a highly sensitive detectaphone by using this Transmitter Button to collect the sound waves. You can build your own outfit without buying expensive equipment. It is simple and inexpensive. You can install an outfit in your home and hear conversations being held all over the house. You can connect up different rooms of a hotel. The outfit is used by secret service operatives during the war. It is being used on the stage. It is ultra-sensitive and is the greatest invention in microphones. You can mount the button almost anywhere—card board boxes, stove pipes, stuff cushions, on the seat or back of chair frame, etc. Button is light and small it cannot be detected. Persons can be overheard without suspecting it. You can listen in on conversations in another room. A deaf person in the audience can hear the speaker. Connected to phonograph, piano or other musical instrument, music can be heard hundreds of feet away. Button may be used to renew telephone transmitters; often makes an old line "talk up" when nothing else will. The ideal microphone for radio use; carries heavy current and is extremely sensitive. Amplifies radio signals. Countless other similar uses will suggest themselves. Experimenters find the button useful for hundreds of experiments along the lines of telephones, amplifiers, loud speakers, etc. Many fascinating stunts may be devised, such as holding the button against the throat or chest to reproduce speech without sound waves. **PRICE $1.00.**

JOHNSON SMITH & CO., DEPT. 906, RACINE, WIS.

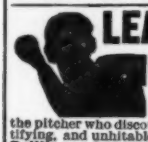
BOYS! BOYS! BOYS!

Throw Your Voice

Into a trunk, under the bed, under a table, back of the door, into a desk at school, or anywhere. You get lots of fun fooling the teacher, policemen, peddlers, and surprise and fool all your friends besides.

THE VENTRILO

is a little instrument that fits in the mouth out of sight. Cannot be detected. It is used in connection with the above, and with the aid of this wonderful **DOUBLE THROAT**, or **VENTRILO**, you can imitate many kinds of birds, animals, etc. Remember you get everything for **ONLY TEN CENTS**—a booklet giving you full instructions how to become a ventriloquist and throw your voice, the **Double Throat**, or **Ventrilo**, and our big 600 page catalog of novelties, tricks, puzzles, masks, books, etc., **ALL SENT POSTPAID TO ANY ADDRESS FOR ONLY 10 cents**



LEARN TO PITCH

By the world's greatest pitchers. Prepares you mentally, morally and physically to become a great baseball player and a great athlete. Special course of lessons by **CHRISTY MATHEWSON**, who explains the secret of how to throw the great **"FADEAWAY"** ball, so much feared by the great batters; **ED WALSH**, the pitcher who discovered the secret of throwing that famous, mystifying, and unhitable **"SPIT BALL"**; **JOE WOOD**, the **"Smoke Ball"** marvel, next to the speediest pitcher in the world; **WALTER JOHNSON**, the man who has struck out more league batters in a single season than any other pitcher known; **NAP RUCKER**, inventor of the **"Knuckle Ball"**; and **DOC WHITE**, who teaches you the art of **Shadow Pitching** by which you can develop control and speed necessary to become a star pitcher. Clearly described and illustrated by 56 pictures. Everything complete for **ONLY 25 cents postpaid anywhere.** Nothing more to buy.

U. S. BABY TANK

25 Cents

It goes with real Yankee Pep—by its own power

Most remarkable toy ever invented. By drawing the Tank backward, either with the hand or over the floor or table and then placing it down, it will crawl along, overcoming all obstacles, in the same lifelike manner as the larger Tank that proved so deadly in the great war. What makes it go is somewhat of a mystery, for there no mechanism to wind up as is usually understood with mechanical toys, yet this tank will keep plodding along ten times longer than the ordinary run of toys. It will perform dozens of the most wonderful stunts; 2½ inches long. **Price only 25c prepaid. Stamps accepted.**
JOHNSON SMITH & CO.

KEYLESS COMBINATION LOCK

These clever Locks cannot be opened unless you know the combination. Each Lock has a different combination, the secret of which we send with the Lock. No key is necessary, simply arrange the tumblers in the proper order and the Lock opens. For your locker, bicycle, tool chest, mail box, thousands of uses. A good, strong lock, weighing about 4 ounces, that will baffle the attempts of all unacquainted with the secret combination to open it. **Price,** with secret and full instructions **only 50c postpaid.**
JOHNSON SMITH & CO., Dept. 906, RACINE, WIS.

Great Fire Eater

A great trick by which you can apparently breathe fire from mouth, to the horror and consternation of all. Quite harmless. All apparatus necessary sent complete in box for **ONLY 30c. p. pd. JOHNSON SMITH**

SEEBACKROSCOPE

Place this clever instrument to your eye, you see what is going on behind your back. Very interesting things sometimes occur when no one thinks you are looking. Just like having eyes at the back of your head.

PRICE 25c POSTPAID

Send remittance (Postage Stamps accepted) for all articles listed above also to our other ad on previous page

SQUIRT ROSE

25c

A REAL STARTLER. This is the most popular of all squirt tricks. The flower in your coat looks so fresh and sweet that everyone is tempted to inhale the delightful perfume. Then is the moment to press the bulb. Gerwhillikens. Don't they jump? There is a very long rubber tube that easily reaches to the pocket of your coat or trousers, and the bulb is large enough to make a dozen shots with one loading. **PRICE 25c each, or 3 for 60c postpaid.**

JOHNSON SMITH & CO. Dept. 906, Racine, Wis.

MAGICIAN'S BOX OF TRICKS

Apparatus and Directions for a Number of Mysterious Tricks, Enough for an Entire Evening's Entertainment..... $1.00

ANYONE CAN DO THEM

It is great fun mystifying your friends. Get this Conjurer's Cabinet, and you will be the cleverest fellow in your district. It contains the apparatus for ten first-class tricks, including The MAGIC BALL AND VASE TRICK (a wooden ball is placed inside, and upon replacing the lid has disappeared and is found in someone else's pocket); The HINDOO TRICK CARDS (can be made to change completely no less than five times); DISAPPEARING COIN BOX (a coin, placed in the wooden box, vanishes entirely or changes into a coin of another denomination); The GLASS GOBLET TRICK (a coin is dropped into a glass of water and when the water is poured out the coin has vanished and is found somewhere else); the RIBBON FACTORY FROM THE MOUTH TRICK (a seemingly endless supply of colored paper ribbons comes out of your mouth); the DISAPPEARING HANDKERCHIEF (a handkerchief held in the hand mysteriously vanishes); the WIZARD'S RING COIN TRICK; the ENCHANTED BOTTLE (no one but yourself is able to make it lay down); the GREAT HAT AND DICE TRICK (a large dice is placed on top of a hat, disappears, and is found underneath yet no one has touched the hat), and last, but not least, the GREAT PHANTOM CARD TRICK, or two from five leaves nothing. Full instructions are sent for performing each trick. In addition to the above, a number of other feats and illusions are fully explained for which you can easily make or procure the necessary apparatus. **Price complete $1.00 postpaid. JOHNSON SMITH & CO.**

RESURRECTION PLANT

Great curiosity. Place in water, plant opens up and starts to grow in few minutes. Taken out it dries up and goes to sleep until put in water again.

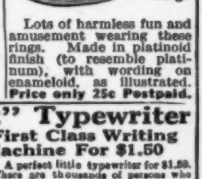
PRICE 10c, 3 for 25c, 75c dozen, postpaid.

DISSOLVING VIEWS

50c

You may have a lot of fun with this little peep-show. A regular startler. Made entirely of metal, having a microscopic lens fitted to one end. While the victim is absorbed in admiration of the pretty picture, and turns the button in the confident expectation of seeing something interesting, a spring syringe is brought into action, and the observer experiences a very great surprise. **50c p. pd.**
Johnson Smith & Co., Dept. 906, Racine, Wis.

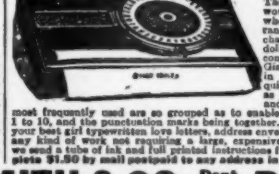
Comical Motto Rings



Lots of harmless fun and amusement wearing these rings. Made in platinoid finish (so resemble platinum), with wording on enameloid, as illustrated. **Price only 25c Postpaid.**

The "Little Giant" Typewriter

A First Class Writing Machine For $1.50



A perfect little typewriter for $1.50. There are thousands of persons who would like to use a typewriter but whose needs and business do not warrant the expense attached to the purchase and use of a fifty or seventy-five dollar machine. To such persons we confidently recommend our Little Giant. It is strongly made, but simple in construction, so that anyone can quickly learn to operate it, and write as rapidly as they would with pen and ink. The letters of the alphabet most frequently used are so grouped as to enable one to write rapidly, the numerals 1 to 10, and the punctuation marks being together. With this machine you can send your best girl typewritten love letters, address envelopes, make out bills, and do almost any kind of work not requiring a large, expensive machine. With each typewriter we send a tube of ink and full printed instructions for using the machine. **Price complete $1.50 by mail postpaid to any address in the world.**

Stop and think for a moment. How would you like to have your own spending money—and besides that earn such prizes as a bicycle, sporting goods and scout equipment? You can do both by being a Crowell Junior Salesman. Every week Crowell Junior Salesmen deliver three of the best known magazines to regular customers. It takes but a small part of their spare time and does not interfere with their fun. You can do the same if you just stop for a moment. Look at the coupon —Sign your name and address—Mail it at once.

Mr. Jim Thayer, Dept. 96,
The Crowell Publishing Co.,
Springfield, Ohio.

Dear Mr. Thayer: I want to earn money and prizes. Please start me off as a salesman.

Name .....

Address .....

Town ..... State.....

Ford Powered Motor Boats

(Continued from page 103)

come already fitted together by manufacturer and are ready to attach. In operation the pump draws through the water bottom, keeping the oil pan cold, and circulates the water under pressure through the motor.

For boat installation a ball-thrust is needed to take the thrust off the motor. This part is illustrated. It is made by cutting off the torque tube and attaching ball races improvised from Ford thrust bearings, but can be purchased complete from manufacturers for nine dollars. The standard universal joint in the motor is used, and in installation the motor may be tipped up to six degrees if necessary, a very valuable factor in small craft. The manufacturers of conversion parts also supply a complete knocked-down engine bed, with brackets, costing less than six dollars, should the builder not wish to make them himself.

Total Cost of Power Plant Is $190

The builder who does not wish to use a rebuilt motor can purchase a new one, complete with transmission, from the factory agencies for about a hundred dollars. Starter and generator and battery cost $30 additional, if new, or about $15 if rebuilt. All the conversion parts, if purchased made-up and ready to attach, cost around $60. Thus the complete power plant, new, costs about $190; or if rebuilt, from $75 to $100. It compares favorably with $500 to $800 standard marine motors, and has all the refinements of expensive marine motors, such as starter, generator, battery for lights, and simple one-lever control. It is a four-cycle motor, vibrationless and practically silent in operation, and delivers 12 h. p. It will drive almost any boat up to 26 feet at good speed, and with reduction gear is satisfactory for craft up to 36 feet in length. It is particularly adapted for use in craft built by the amateur boat enthusiast who must keep down his costs. The amateur can build a very good 18- or 20-foot V-bottom runabout for this motor for around a hundred dollars, and complete with power plant, shafting and wheel, lights, and other equipment, he can have a craft for less than $250 which will do 16 to 20 miles an hour and give him maximum service for many years.

"Take it easy for a while!" said a fresh young voice. "That was a narrow escape."

"14 WORDS *of* Magic Power"

—that is what the multi-millionaire gave to the young man who saved his life. He wouldn't give MONEY because given money usually breeds neglected opportunities. He couldn't give him a JOB because the young man didn't know enough. So he gave him instead that which had enabled himself to create his millions: FOURTEEN WORDS OF MAGIC POWER, and when that young man understood and used those fourteen words, *they* made him worth a *quarter of a million dollars in five years.*

What Are the Fourteen Magic Words?

You'll never know *until* you have read this fascinating little copyrighted story book by Charles Henry Mackintosh. It won't cost you a cent to do so and it may be worth a quarter of a million to *you* as it was to Arthur Holmes. *You* can understand the Magic Words and *you* can *use* them; if you *do* use them as Holmes did they should also make you rich, famous, useful and happy and *bring you whatever you want.*

This Fascinating Story Book Free—IF

I will send you this story FREE,—(1) *if* you are an ambitious forward-looking young man between the ages of 16 and 32. (2) *If* you live in the United States or Canada (others enclose $1.00), and (3) *if* you are willing to consider (without obligation) using a part of your spare time in preparing to fill a *worth-while* position in the big-pay fields of Drafting, Engineering, Electricity or Architecture. Such positions are open to men who take training under any one of these three plans:

FIRST: A regular three year (B. S. Degree) Course or a two year (Diploma) Course in Engineering or Architecture at Chicago Technical College. This well-known school has had 25 years' experience in training young men for the *higher salaried* positions. Opportunities to earn while learning. Day and Evening Classes,—or

SECOND: A short 4 Months' Special Course in Mechanical, Electrical, Structural or Architectural *Drafting.* We help you to secure position when through training,—or

THIRD: Train at Home in Drafting. Keep your present job and prepare for a better one in spare time right in your own home. All tools furnished without extra cost.

Mail the Coupon---READ WITH PROFIT

Send for this little book and read the fascinating story—the FOURTEEN WORDS and what they did—and may do for YOU! I'll send it Free! I only ask that you *carefully* fill out the coupon below.

Actual Size 3½"x5¼"

FREE to YOU
in return for
THIS COUPON
Chicago Tech. College
Dept. H-42
Chicago Tech. Bldg.
118 E. 26th St. CHICAGO, ILL.

"14 Words of Magic Power"-FREE Coupon

Charles W. Morey, President, Chicago Technical College, Dept. H-42, Chicago Tech. Bldg.,(22d St. Sta.), Chicago, Ill.

Send me "FOURTEEN WORDS OF MAGIC POWER." It's agreed that I pay you nothing and owe you nothing in return, but I *am* interested in knowing more about the plan I have checked below:

Your Name.....*Age*.....

Home Address .....

Town or City.....*State*.....

Present Occupation .....

Check Here the Plan You Like Best

Regular Training 2 yr. or 3 yr. (B.S.) at Chicago Tech. ☐

Short 4 Months' Drafting at Chicago Tech. ☐

Training at My Home for Drafting Job ☐

FLY THIS LINDYTYPE AIRPLANE

$1

BUILT UP

NEW LOW PRICE POSTPAID

CABIN MODEL "SPIRIT OF ST. LOUIS"

Airworthy plane developed by World War Aviator to rise off ground and complete hundreds of flights. Pleased purchasers say performance matches their $5 models. Ship resembles original in every detail, even to "Lone Eagle" at controls. Tough 1½-foot Mitchfibre wing and 12-inch fuselage withstand any crash. Finished in BRILLIANT SILVER LUSTRE. Weighs 1½ oz. Simple assembling outfit furnishes an evening's fun. Anyone can build or fly it. Goes together without tools. Includes 6-inch propeller, readi-cut wood struts, Clark "Y" wing ribs, full directions, all complete, postpaid U. S., $1. Canada, $1.20.

RECORD PRIZE-WINNING MODELS

These kits contain everything needed to build PRIZE-WINNING models, eligible for all official U. S. contests. Designed by experienced aeronautical engineer to qualify your entry as a first place leader. Latest and tested wrinkles for winning contests included in plans and direction data.

INDOOR RECORD SMASHER, the type that has flown over 300 seconds. Special balsa with new $ light fittings. Canada, postpaid, $1.20. U. S., postpaid 1

SKEETER-BUG HYDROPLANE, skims off water, flies 20 seconds and lights gracefully on water $ again. Dandy Summer Camp model. Canada, postpaid, $1.20. U. S., postpaid 1

FAIRCHILD CABIN PLANE, with exclusive features to insure stability and balance, making certain $ perfect flights covering hundreds of feet. Canada, postpaid, $2.20. U. S., postpaid 2

40-Inch Outdoor Twin-Motored Endurance model. Has flown over 10 minutes. Graceful, powerful $ flyer you will be proud to own. Canada, postpaid, $3.30. U. S., postpaid 3

SPECIAL LOW PRICE

FAST FIGHTING U. S. ARMY PURSUIT PLANE, model of world's premier fighting ship—the Curtiss Hawk. Beautiful scale model that flies gracefully yet follows lines of original faithfully and accurate- $ ly. Special low price to Canada, $5.50, U. S., postpaid 5

Get Our Prices on Supplies. Catalog, 10c.

MODEL AIRCRAFT SUPPLY

Box 316 CHILLICOTHE, OHIO

TEAR OUT—MAIL TODAY

MODEL AIRCRAFT SUPPLY,
Box 316, Chillicothe, Ohio. Date.....

Gentlemen: I enclose $.....for which send me, right away, Model Kits I have checked below:

☐ Spirit of St. Louis $1 ☐ Fairchild Cabin $2
☐ Indoor Record Holder $1 ☐ Outdoor Twin Pusher $3
☐ Hydroplane $1 ☐ Curtiss Hawk $5
☐ Catalog 10c

Name .....

Address .....

City and State.....

Please write plainly.

Guaranteed to Fly- or Money Back

Flyers Have the World's Strangest Club

(Continued from page 58)

near Robbinsdale, Minn., one Sunday about two years ago, a comely girl answered a newspaper want ad, stating she was an experienced parachute jumper and would consider the proposition of the local air man for an exhibition jump that day. The jump was to be the crowd-attracting feature.

Hanging on to a strut, with the exhibition type parachute sack tied to the strut for a drop-away jump, the girl and the pilot took off. Given the proper signal, the girl closed her eyes and let loose. The shrouds of the harness got jammed in the strut, and the drop was checked when she was twenty feet or so down. Helplessly the pilot cruised above the airport, unable to land without certainly dashing the girl's brains out on the ground.

Wing Walker Stages Rescue

Another ship took to the air with a man hanging to the strut. By careful flying the two ships were flown close enough together so that a ship-to-ship change in the air was made. The daring wing walker now made his way to the strut from which the shrouds were hanging, and cutting the sack in which the chute was encased, he freed the girl.

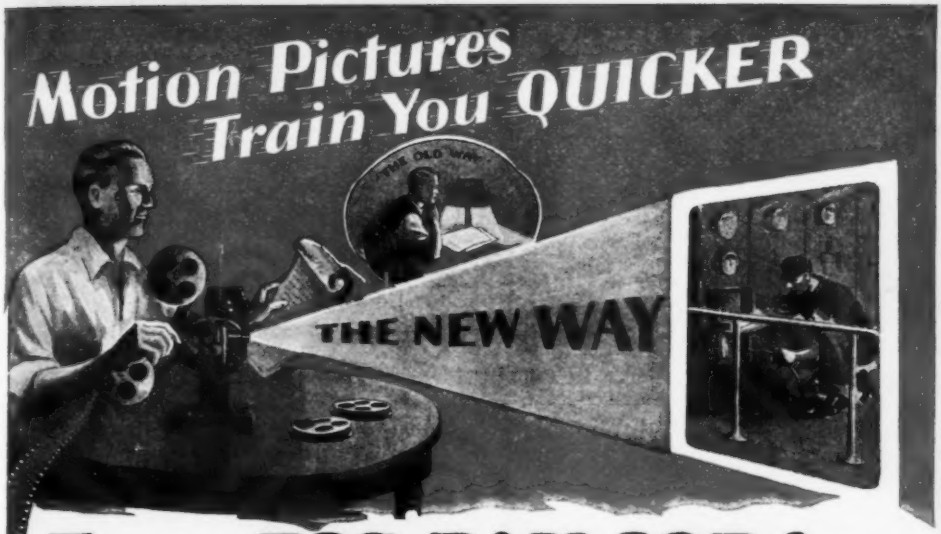
But that's not all! The girl, it so happened, had never made a jump before. She was either desperate for money, or out for a thrill. She got both! Imagine if you can, having yourself freed from a predicament like the above, floating downward in a parachute—right into the middle of a lake, when you couldn't even swim! That was the girl's fate! Fortunately she was rescued by fishermen, and was returned to the field physically none the worse for her adventure. The girl's name is Frances Clark.

Then they tell the story of a high ranking air corps officer who was making a tour of inspection of the various fields in the United States. He came down one noon on one of the largest army fields in the country and the wing of his pursuit plane struck a stump—the only object on the field of more than 600 acres. This high officer had hit a grass roller and left for another station that day as a member of the local club recognizing such feats.

However, though the exploits of the

(Continued on page 170)

Motion Pictures Train You QUICKER



For a BIG-PAY JOB in ELECTRICITY

NOW—it's easy to get a better job with bigger pay—to get ahead—to save money—to become independent.

Everybody agrees that the field of ELECTRICITY is where the real opportunities are today and will be for years to come. And here is an amazing new way to sure success in ELECTRICITY. It will startle you with its improvement over old methods.

Now you learn from MOTION PICTURES right in your own home. You get a $75 DeVry motion picture machine without extra cost. You are furnished thousands of feet of film. You watch the motion pictures. You see giant dynamos in operation, moving diagrams, trained men at actual electrical work. It's so plain and easy anyone can understand. What your eye sees your mind remembers. It's just as easy as it sounds. Students everywhere are enthusiastic. You will be too. So lose no time in finding out all about this newest, quickest, easiest way to train for a big-money job.

The NEW WAY *Is the Best Way*

Just as the giant electric locomotives of today are superior to the first wheezy old steam engines. As the 150 mile an hour monoplane is swifter than the Pony Express. So is our new MOTION PICTURE electric training quicker, better and easier than the old hard to learn book methods. E. A. B., Brooklyn, N.Y., says "I finished Reel Lesson No. 3 today and certainly can understand now why you claim your course is so easy to learn. The films make it easy to grasp any point."

Make $60 to $150 a Week

Thousands of trained men are needed in the electrical field. Demand exceeds supply. $60.00 to $150.00 or more per week is common. You can get in on this big money. You take no risk. We guarantee in writing to give you the training and employment service necessary to get a better job at bigger pay or you need not pay a cent.

Write Now for Big FREE Book It costs you nothing to get all the facts on this remarkable new MOTION PICTURE method. Our big FREE Book, The Film Way to Bigger Pay, tells you just how we train you for a bigger job. Send for it today. Find out how easy it now is to qualify for the big money. Mail coupon and get the facts.

TAKE THE FILM WAY TO BIGGER PAY

The NATIONAL SCHOOL of VISUAL EDUCATION

"The Film Way to Bigger Pay"
537 S. Dearborn Street, Chicago, U. S. A. Dept. 7-L
Send book, "The Film Way to Bigger Pay," with facts about this new, easier way to master electricity.

Name.....Age.....
St. or R.F.D.....
City.....State.....

Mail this Coupon

Betty Compson

Paramount's beautiful Star, has a surprising treat in store for all movie fans in her story:

"My Life Among the Stars"

It appears in the JULY

Screen Secrets

the popular movie magazine

These exclusive features are also listed in the JULY *contents:*

Personality stories about Marion Nixon, Norma Talmadge, Victor MacLaglen, Aileen Pringle, and others.

Robert Sherwood's amusing observations on the movies.

The latest developments in the talkies.

Harry Carr's comments on stars and studios.

Up-to-the-minute reviews of the latest films.

The July issue is on sale June 10th

If your newsdealer is sold out, send $1 (bill or stamps) and Screen Secrets will be mailed to you for the next five months. Or send 25c for a copy of the July issue. Address your letter:
SCREEN SECRETS MAGAZINE
Fawcett Publications, Inc., Minneapolis, Minn.

Flyers Have World's

army's Flying Jackasses and Dumb-bells are highly interesting because they are colored by a background of high grade equipment and the finest possible training, the real romance of incidents of the air comes from commercial pilots. They have ships which must be kept going in order to provide their owners with the staff of life, and the predicaments these flyers sometimes find themselves in are amusing—after they are over.

For instance, Gene Shank, one of MODERN MECHANICS' aviation editors, tells of the time he was barnstorming an Aeromarine flying boat on one of the lakes in the northern summer resort region.

The day had been clear, but gusty, with an east wind blowing across the narrow part of the lake, making a takeoff difficult. The sun was sinking, the day was nearly over, when a load of passengers drove up to the shore base, paid for a ride, and insisted on a "hop." Pilot Shank loaded them in, headed down wind, gave her the gun, and was barely clear when the motor quit, out of gas!

Rescue on the Wing

The sun was soon down, it was dark, and the boat was at the mercy of the strong easterly wind.

It so happened that the lake had several islands in it, with rocky points jutting out so as to overlap each other in the path of the wind. After drifting past one island, into the lee, the plane started drifting for the windward shore of the lake, where the water was rougher and the plane would surely suffer grief.

The plane was about two wing lengths from the second point. It was impossible to reach it with a rope or boat hook, so one man crawled out on the wing nearest shore, and hanging in the water from the wing, kicked vigorously so as to stop the drift in that direction. As on a pivot the other wing swung around, and by sending a man over the opposite wing from which the panting, kicking, dragging swimmer was pendent, the second man was able to step off a few feet of water and nose the ship ashore, thus saving the fair cargo!

At another time, with a Curtiss flying boat, a pilot was hopping passengers on the well known two-for-five plan. Two girls, giggling, thrilled, and scared, board-

ed the plane and seriously asked the pilot if he thought he would bring them down alive. Jokingly he remarked that he had a premonition that this would be his last trip—that he felt his end near.

Imagine the lump in his throat when, upon taking off, he found his tail surface control gone! Cut wires, plots! Other possibilities raced through his mind, until, upon looking back, he saw that a large hatch, about five feet square, had not been clamped down, and was standing up, supported by wind pressure, dancing daintily against the motor struts and waiting at any time to slip off into the pusher propeller!

The hatch had blanketed the air stream so that no solid air was going past the tail surfaces, and there was no tail control at all. The pilot gingerly closed the loose hatch with one hand, while standing up and flying with the other, all the time praying that the flimsy pegs which held the hatch would not slip loose and mix the hatch up with the prop.

Flying Without Landing Gear

Pilot Shank also tells one which is remarkable in that it exhibits the seemingly impossible type of flying which experienced men can pull off and get away with. In this particular instance, Shank had been test hopping a new Jenny. He came down, let the ship's motor run, and walked across the road from the tarmac for a drink of pop and a piece of candy. While he was gone, some other pilot removed a wheel from the Jenny intending to replace it after one hop on another ship. In fact, so bent was he on getting the other ship into the air, that the wheel he put on the Jenny with a slightly deflated tire, was not keyed on at all. Shank just then had a customer for a short hop, and taking off with the Jenny, imagine his s u r p r i s e upon looking overside as he climbed, to see a wheel go racing along beside him!

"I could only make a wild guess as to which wheel was off," says Shank, "but I figured it was the left wheel as that was the side I saw the wheel travelling on. Landing on one wheel is no cinch, even without a joy-rider along. I swung around cross wind, keeping the left wing into the breeze, and made a cross wind landing, cocking the left wing up high and holding her off as long as I could. When she came down on

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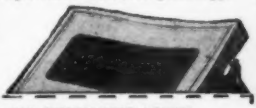

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Flyers Have Strangest Club

the axle she was only going about fifteen miles an hour, and though the ground loop was a lulu, the ship only ploughed up a little sod. No one was hurt."

Equally amusing are the incidents related by Dick Grace, movie flyer of renown. One of them relates the predicament of the man who underbid him on a stunt for the movies. For a sum of around $2,000 this flyer agreed to fly a ship into the range of the camera, touch off a fuse, jump out, and let the ship blow to bits while he parachuted to earth. The time fuse, set at ten seconds, was faulty, and the charge of dynamite with which the front cockpit was loaded went off instantaneously. The pilot was blown out of the ship in an upward direction, with his chute opening! It ignited, and as he fell through space, the flyer slipped the chute, smothered the flame, released the chute again, and landed safely in the ocean, bemoaning the fact that his pet chute was demolished!

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Carter of the Red Planet

(Continued from page 121)

fore me, saying,

"No one comes from Than Kosis without carrying an order or the pass word. You must give me one or the other before you may pass."

"The only order I require, my friend, to enter where I will, hangs at my side," I answered, tapping my long-sword; "will you let me pass in peace or no?"

For reply he whipped out his own sword, calling to the others to join him, and thus the four stood, with drawn weapons.

My reply was a quick thrust which left me but three antagonists and I can assure you that they were worthy of my metal. They had me backed against the wall in no time, fighting for my life. Slowly I worked my way to a corner of the room where I could force them to come at me only one at a time, and thus we fought upward of twenty minutes; the clanging of steel on steel producing a veritable bedlam in the little room.

The noise had brought Dejah Thoris to the door of her apartment, and there she stood throughout the conflict with Sola at her back peering over her shoulder. Her face was set and emotionless and I knew that she did not recognize me, nor did Sola.

Finally a lucky cut brought down a second guardsman and then, with only two opposing me, I changed my tactics and rushed them down after the fashion of my fighting that had won me many a victory. The third fell within ten seconds after the second, and the last lay dead upon the bloody floor a few moments later.

Sheathing my bloody blade I advanced toward my Martian Princess, who still stood mutely gazing at me without sign of recognition.

"Who are you, Zodangan?" she whispered. "Another enemy to harass me in my misery?"

"I am a friend," I answered, "a once cherished friend."

"No friend of Helium's princess wears that metal," she replied, "and yet the voice! I have heard it before; it is not—it cannot be—no, for he is dead."

"It is, though, my Princess, none other than John Carter," I said. "Do you not recognize, even through paint and strange metal, the heart of your chieftain?"

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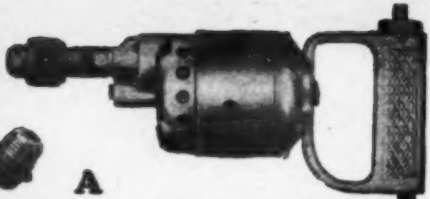

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Carter of the

As I came close to her she swayed toward me with outstretched hands, but as I reached to take her in my arms she drew back with a shudder and a little moan of misery.

"Too late, too late," she grieved. "O my chieftain that was, and whom I thought dead, had you but returned one little hour before—but now it is too late, too late."

"What do you mean, Dejah Thoris?" I cried. "That you would not have promised yourself to the Zodangan prince had you known that I lived?"

"Think you, John Carter, that I would give my heart to you yesterday and today to another? I thought that it lay buried with your ashes in the pits of Warhoon, and so today I have promised my body to another to save my people from the curse of a victorious Zodangan army."

"But I am not dead, my princess. I have come to claim you, and all Zodanga cannot prevent it."

"It is too late, John Carter, my promise is given, and on Barsoom that is final."

"I know but little of your customs here upon Barsoom, Dejah Thoris, but I do know that I love you, and if you meant the last words you spoke to me that day as the hordes of Warhoon were charging down upon us, no other man shall ever claim you as his bride."

"No, John Carter, it is useless," she cried. hopelessly, "I may never be yours while Sab Than lives."

"You have sealed his death warrant, my princess—Sab Than dies."

"Nor that either," she hastened to explain. "I may not wed the man who slays my husband, even in self-defense. You may go now, nor ever see me again. Goodbye, my chieftain that was."

Disheartened and dejected, I withdrew from the room, but I was not entirely discouraged, nor would I admit that Dejah Thoris was lost to me until the ceremony had actually been performed.

As I wandered along the corridors, I was as absolutely lost in the mazes of winding passageways as I had been before I discovered Dejah Thoris' apartments.

I knew that my only hope lay in escape from the city of Zodanga, for the matter of the four dead guardsmen would have to be explained. Presently I came upon a spiral runway leading to a lower floor, and

this I followed downward for several stories until I reached a doorway.

Without effort at concealment I hastened to the vicinity of our quarters, where I felt sure I should find Kantos Kan. My only means of reaching, unseen, the upper story where our apartments were situated was through an adjoining building, and after considerable maneuvering I managed to attain the roof of a shop several doors away.

Leaping from roof to roof, I soon reached an open window in the building where I hoped to find the Heliumite, and in another moment I stood in the room before him.

I saw that he knew nothing of the events of the day at the palace, and when I had enlightened him he was all excitement. The news that Dejah Thoris had promised her hand to Sab Than filled him with dismay.

"It cannot be," he exclaimed. "It is impossible! Why no man in all Helium but would prefer death to the selling of our loved princess to the ruling house of Zodanga."

"If I can come within sword's reach of Sab Than," I said, "I can solve the difficulty in so far as Helium is concerned, but for personal reasons I would prefer that another struck the blow that frees Dejah Thoris."

Kantos Kan eyed me narrowly before he spoke.

"You love her!" he said. "Does she know it?"

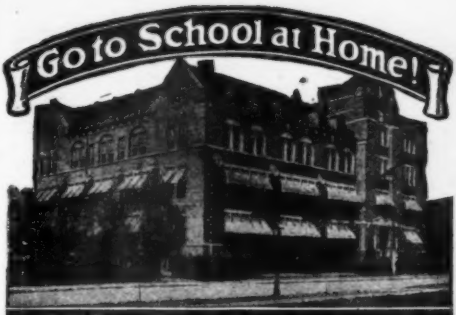
"She knows it, Kantos Kan, and repulses me only because she is promised to Sab Than."

The splendid fellow sprang to his feet, and grasping me by the shoulder raised his sword on high, exclaiming:

"And had the choice been left to me I could not have chosen a more fitting mate for the first princess of Barsoom. Here is my hand upon your shoulder, John Carter, and my word that Sab Than shall go out at the point of my sword for the sake of my love for Helium, for Dejah Thoris, and for you. This very night I shall try to reach his quarters in the palace."

"How?" I asked. "You are strongly guarded and a quadruple force patrols the sky."

He bent his head in thought a moment, then raised it with an air of confidence.



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"I only need to pass these guards and I can do it," he said at last. "I know a secret entrance to the palace through the pinnacle of the highest tower. I fell upon it by chance one day as I was passing above the palace on patrol duty. If I can reach the roof of the barracks and get my machine I can be in Sab Than's quarters in five minutes; but how am I to escape from this building, guarded as you say it is?"

"How well are the machine sheds at the barracks guarded?" I asked.

"There is usually but one man on duty there at night upon the roof."

"Go to the roof of this building, Kantos Kan, and wait me there."

Without stopping to explain my plans I retraced my way to the street and hastened to the barracks. I did not dare to enter the building, filled as it was with members of the air-scout squadron, who, in common with all Zodanga, were on the lookout for me.

It was a long climb up the face of the building, and one fraught with much danger, but there was no other way, and so I essayed the task. I found ornamental ledges and projections which fairly formed a perfect ladder for me all the way to the eaves of the building. Here I met my first real obstacle. The eaves projected nearly twenty feet from the wall to which I clung, and though I encircled the great building I could find no opening through them.

There was one slight, desperate chance, and that I decided I must take—it was for Dejah Thoris, and no man has lived who would not risk a thousand deaths for such as she.

Clinging to the wall with my feet and one hand, I unloosened the long leather straps of my trapping at the end of which dangled a great hook by which air sailors are hung to the sides and bottoms of their craft for various purposes of repair.

I swung this hook cautiously to the roof several times before it finally found lodgment; gently I pulled on it to strengthen its hold, but whether it would bear the weight of my body I did not know.

An instant I hesitated, and then, releasing my grasp upon the supporting ornament, I swung out into space at the end of the strap. Clambering quickly aloft I grasped the edge of the eaves and drew myself to the surface of the roof above.

Red Planet

Donning my trappings and weapons I hastened to the sheds, and soon had out both my machine and Kantos Kan's. Making his fast behind mine I started my engine, and skimming over the edge of the roof I dove down into the streets of the city far below the plane usually occupied by the air patrol. In less than a minute I was settling safely upon the roof of our apartment beside the astonished Kantos Kan.

I lost no time in explanations, but plunged immediately into a discussion of our plans for the immediate future. It was decided that I was to try to make Helium while Kantos Kan was to enter the palace and dispatch Sab Than. If successful he was then to follow me. He set my compass for me, a clever little device which will remain steadfastly fixed upon any given point on the surface of Barsoom, and bidding each other farewell we rose together and sped in the direction of the palace which lay in the route which I must take to reach Helium.

As we neared the high tower a patrol shot down from above, throwing its piercing searchlight full upon my craft, and a voice roared out a command to halt, following with a shot as I paid no attention to his hail. Kantos Kan dropped quickly into the darkness, while I rose steadily and at terrific speed raced through the Martian sky followed by a dozen of the air-scout craft which had joined the pursuit.

As I sped through the air the screeching of the bullets around me convinced me that only by a miracle could I escape, but the die was cast, and throwing on full speed I raced a straight course toward Helium. Gradually I left my pursuers further and further behind, and I was just congratulating myself on my lucky escape, when a well-directed shot from the cruiser exploded at the prow of my little craft.

How far I fell before I regained control of the plane I do not know, but I must have been very close to the ground.

Rising again I scanned the heavens for my pursuers, and finally making out their lights far behind me, saw that they were landing, evidently in search of me.

Not until their lights were no longer discernible did I venture to flash my little lamp upon my compass, and then I found to my consternation that a fragment of the

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Carter of the Red Planet

projectile had utterly destroyed my only guide, as well as my speedometer.

Helium lies a thousand miles southwest of Zodanga, and with my compass intact I should have made the trip, barring accidents, in between four and five hours. As it turned out, however, morning found me speeding over a vast expanse of dead sea bottom after nearly six hours of continuous flight at high speed.

About noon I passed low over a great dead city of ancient Mars, and as I skimmed out across the plain beyond I came full upon several thousand green warriors engaged in a terrific battle. Scarcely had I seen them than a volley of shots was directed at me, and with the almost unfailing accuracy of their aim my little craft was instantly a ruined wreck, sinking erratically to the ground.

I fell almost directly in the center of the fierce combat, among warriors who had not seen my approach so busily were they engaged in life and death struggles.

As my machine sank among them I realized that it was fight or die, with good chances of dying in any event, and so I struck the ground with drawn long-sword ready to defend myself as I could.

I fell beside a huge monster who was engaged with three antagonists, and as I glanced at his fierce face, filled with the light of battle, I recognized Tars Tarkas the Thark. He did not see me, as I was a trifle behind him, and just then the three warriors opposing him, and whom I recognized as Warhoons, charged simultaneously. Quick as lightning they were upon him, and Tars Tarkas would have been gathered to his fathers in short order had I not sprung before his prostrate form and engaged his adversaries. I had accounted for one of them when the mighty Thark regained his feet and quickly settled the other.

He gave me one look, and a slight smile touched his grim lips as, touching my shoulder, he said,

"I would scarcely recognize you, John Carter, but there is no other mortal upon Barsoom who would have done what you have for me. I think I have learned that there is such a thing as friendship, my friend."

He said no more, nor was there opportunity, for the Warhoons were closing in about us, and together we fought, shoulder

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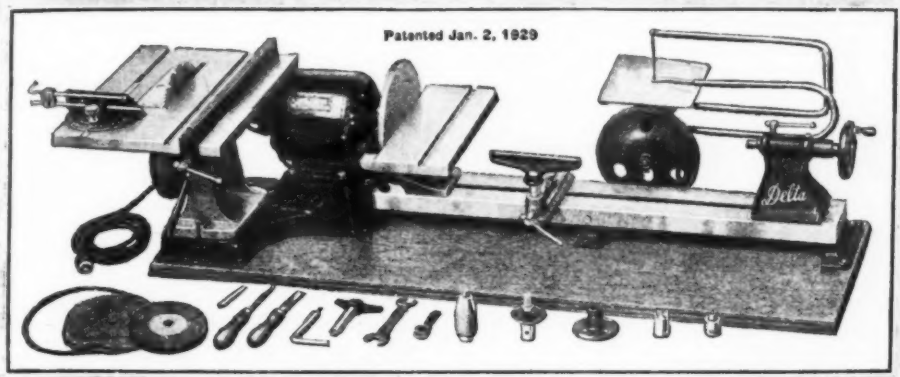

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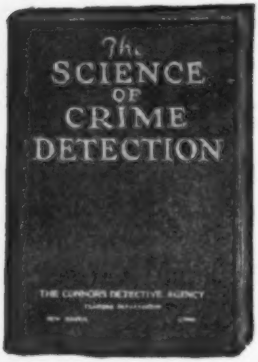

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to shoulder, during all that long, hot afternoon, until the tide of battle turned and the remnant of the fierce Warhoon horde fell back upon their thoats, and fled into the gathering darkness.

On our return to the city after the battle we had gone directly to Tars Tarkas' quarters, where I was left alone while the chieftain attended the customary council which immediately follows an engagement.

"Tal Hajus knows that you are here, John Carter," said Tars Tarkas, on his return from the jeddak's quarters; "Sarkoja saw and recognized you as we were returning. Tal Hajus has ordered me to bring you before him tonight. I have ten thoats, John Carter; you may take your choice from among them, and I will accompany you to the nearest waterway that leads to Helium. Tars Tarkas may be a cruel green warrior, but he can be a friend as well. Come, we must start."

"And when you return, Tars Tarkas?" I asked.

"The wild calots, possibly, or worse," he replied.

"We will stay, Tars Tarkas, and see Tal Hajus tonight. You shall not sacrifice yourself, and it may be that tonight you can have the chance you wait."

While we were eating I repeated to Tars Tarkas the story which Sola had told me that night upon the sea bottom during the march to Thark.

He said but little, but the great muscles of his face worked in passion and in agony at recollection of the horrors which had been heaped upon the only thing he had ever loved in all his cold, cruel, terrible existence.

He no longer demurred when I suggested that we go before Tal Hajus, only saying that he would like to speak to Sarkoja first. At his request I accompanied him to her quarters.

"Sarkoja," said Tars Tarkas, "forty years ago you were instrumental in bringing about the torture and death of a woman named Gozava. I have just discovered that the warrior who loved that woman has learned of your part in the transaction. He may not kill you, Sarkoja, it is not our custom, but there is nothing to prevent him tying one end of a strap about your neck and the other end to a wild thoat, merely

to test your fitness to survive and help perpetuate our race. Having heard that he would do this on the morrow, I thought it only right to warn you, for I am a just man."

The next morning Sarkoja was gone, nor was she ever seen after.

In silence we hastened to the jeddak's chamber and almost at once we were admitted to his presence; in fact, he could scarcely wait to see me and was standing erect upon his platform glowering at the entrance as I came in.

"Strap him to that pillar," he shrieked. "We shall see who it is dares strike the mighty Tal Hajus."

"Chieftains of Thark," I cried, turning to the assembled council and ignoring Tal Hajus, "I have been a chief among you, and today I have fought for Thark shoulder to shoulder with her greatest warrior. You owe me, at least, a hearing."

"Silence," roared Tal Hajus. "Gag the creature and bind him as I command."

"Justice, Tal Hajus," exclaimed Lorquas Ptomel.

"Yes, justice!" echoed a dozen voices, and so, while Tal Hajus fumed and frothed, I continued.

"You are a brave people and you love bravery, but where was your mighty jeddak during the fighting today? I did not see him in the thick of battle; he was not there. He rends defenseless women and little children in his lair, but how recently has one of you seen him fight with men? Is it of such that the Tharks fashion their jeddaks? There stands beside me now a great Thark, a mighty warrior and a noble man. Chieftains, how sounds, Tars Tarkas, Jeddak of Thark?"

A roar of deep-toned applause greeted this suggestion.

"It but remains for this council to command, and Tal Hajus must prove his fitness to rule. Were he a brave man he would invite Tars Tarkas to combat, for he does not love him, but Tal Hajus is afraid; Tal Hajus, your jeddak, is a coward. With my bare hands I could kill him, and he knows it."

After I ceased there was tense silence, as all eyes were riveted upon Tal Hajus. He did not speak or move, but the blotchy green of his countenance turned livid, and the froth froze upon his lips.

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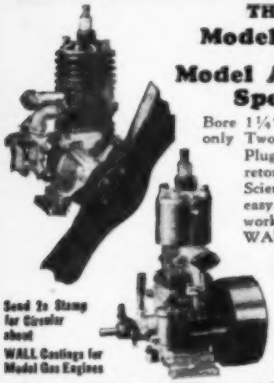

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"Tal Hajus," said Lorquas Ptomel in a cold, hard voice, "never in my long life have I seen a jeddak of the Tharks so humiliated. There could be but one answer to this arraignment. We wait it." And still Tal Hajus stood as though petrified.

"Chieftains," continued Lorquas Ptomel, "shall the jeddak, Tal Hajus, prove his fitness to rule over Tars Tarkas?"

There were twenty chieftains about the rostrum, and twenty swords flashed high in assent.

There was no alternative. That decree was final, and so Tal Hajus drew his longsword and advanced to meet Tars Tarkas.

The combat was soon over, and, with his foot upon the neck of the dead monster, Tars Tarkas became jeddak among the Tharks.

His first act was to make me a full-fledged chieftain with the rank I had won by my combats the first few weeks of my captivity among them.

Seeing the favorable disposition of the warriors toward Tars Tarkas, as well as toward me, I grasped the opportunity to enlist them in my cause against Zodanga. I told Tars Tarkas the story of my adventures, and in a few words had explained to him the thought I had in mind.

"John Carter has made a proposal," he

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said, addressing the council, "which meets with my sanction. I shall put it to you briefly. Dejah Thoris, the Princess of Helium, who was our prisoner, is now held by the jeddak of Zodanga. John Carter suggests that we rescue her and return her to Helium."

It was a chance to fight, an opportunity to loot, and they rose to the bait as a speckled trout to a fly. In three days we were on the march toward Zodanga, one hundred thousand strong, as Tars Tarkas had been able to enlist the services of three smaller hordes on the promise of the great loot of Zodanga.

When we came before Zodanga the task of obtaining entry to the city devolved upon me, and directing Tars Tarkas to hold his forces in two divisions out of earshot of the city, with each division opposite a large gateway, I took twenty dismounted warriors and approached one of the small gates that pierced the walls at short intervals. These gates have no regular guard, but are covered by sentries, who patrol the avenue that encircles the city just within the walls much as our metropolitan police patrol their beats.

The walls of Zodanga are seventy-five feet in height and fifty feet thick. They are built of enormous blocks of carborundum, and the task of entering the city seemed, to my escort of green warriors, an impossibility. The fellows who had been detailed to accompany me were of one of the smaller hordes, and therefore did not know me.

Placing three of them with their faces to the wall and arms locked, I commanded two more to mount to their shoulders, and a sixth I ordered to climb upon the shoulders of the upper two. The head of the topmost warrior towered over forty feet from the ground.

In this way, with ten warriors, I built a series of three steps from the ground to the shoulders of the topmost man. Then starting from a short distance behind them I ran swiftly up from one tier to the next, and with a final bound from the broad shoulders of the highest I clutched the top of the great wall and quietly drew myself to its broad expanse. After me I dragged six lengths of leather from an equal number of my warriors. These lengths we had previously fastened together, and passing

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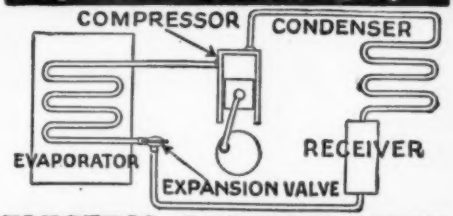

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one end to the topmost warrior I lowered the other end cautiously over the opposite side of the wall toward the avenue below. No one was in sight, so, lowering myself to the end of my leather strap, I dropped the remaining thirty feet to the pavement below.

I had learned from Kantos Kan the secret of opening these gates, and in another moment my twenty great fighting men stood within the doomed city of Zodanga.

Dispatching one of my men to Tars Tarkas for a detail of fifty Tharks, I ordered ten warriors to capture and open one of the great gates while with the nine remaining I took the other. We were to do our work quietly, no shots were to be fired and no general advance made until I had reached the palace with my fifty Tharks. Our plans worked to perfection.

As we approached the palace I could see through the great windows of the first floor into the brilliantly illuminated audience chamber of Than Kosis. The immense hall was crowded with nobles and their women, as though some important function was in progress.

At one end of the chamber, upon massive golden thrones encrusted with diamonds, sat Than Kosis and his consort, surrounded by officers and dignitaries of state. Before them stretched a broad aisle lined on either side with soldiery, and as I looked there entered this aisle at the far end of the hall, the head of a procession which advanced to the foot of the throne.

At the foot of the throne came two figures entirely muffled in scarlet silk, so that not a feature of either was discernible. When the balance of the procession had entered and assumed their stations Than Kosis addressed the couple standing before him. I could not hear his words, but presently two officers advanced and removed the scarlet robe from one of the figures, and I saw that Kantos Kan had failed in his mission, for it was Sab Than, Prince of Zodanga, who stood revealed before me.

Than Kosis now took a set of the ornaments from a salver and placed a collar of gold about his son's neck. After a few more words addressed to Sab Than he turned to the other figure, from which the officers now removed the enshrouding silks, disclosing to my now comprehending view Dejah Thoris, Princess of Helium.

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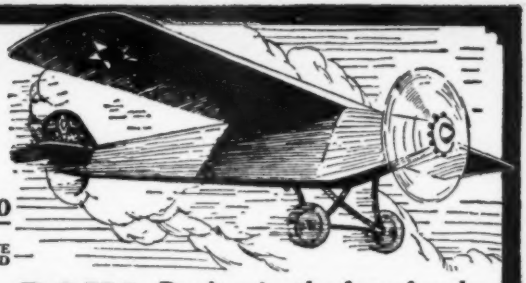

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Carter of the Red Planet

The object of the ceremony was clear to me; in another moment Dejah Thoris would be joined forever to the Prince of Zodanga. With a bound I was on the steps of the platform beside Than Kosis, and as he stood riveted with surprise I brought my long-sword down upon the golden chain that would have bound Dejah Thoris to another.

In an instant all was confusion; a thousand drawn swords menaced me from every quarter, and Sab Than sprang upon me with a jeweled dagger he had drawn from his nuptial ornaments. I could have killed him as easily as I might a fly, but the age-old custom of Barsoom stayed my hand, and grasping his wrist as the dagger flew toward my heart I held him as though in a vise and with my long-sword pointed to the far end of the hall.

"Zodanga has fallen," I cried. "Look!"

All eyes turned in the direction I had indicated, and there, forging through the portals of the entrance-way rode Tars Tarkas and his fifty warriors on their great thoats.

A cry of alarm and amazement broke from the assemblage, but no word of fear, and in a moment the soldiers and nobles of Zodanga were hurling themselves upon the advancing Tharks.

Thrusting Sab Than headlong from the platform, I drew Dejah Thoris to my side. Behind the throne was a narrow doorway and in this Than Kosis now stood facing me, with drawn long-sword. In an instant we were engaged, and I found no mean antagonist.

As we circled upon the broad platform I saw Sab Than rushing up the steps to aid his father, but, as he raised his hand to strike, Dejah Thoris sprang before him and then my sword found the spot that made Sab Than jeddak of Zodanga.

Calling to Dejah Thoris to get behind me I worked my way toward the little doorway back of the throne, but the enemy realized my intentions, and three of them sprang in behind me and blocked my chances for gaining a position where I could have defended Dejah Thoris against an army of swordsmen.

The Tharks were having their hands full in the center of the room, and I began to realize that nothing short of a miracle could save Dejah Thoris and myself, when I saw

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Carter of the Red Planet

Tars Tarkas surging through the crowd of pigmies that swarmed about him.

The bravery of the Zodangans was awe-inspiring, not one attempted to escape, and when the fighting ceased it was because only Tharks remained alive in the great hall, other than Dejah Thoris and myself.

The sounds of heavy firing, mingled with shouts and cries, came to us from the city's streets, and Tars Tarkas hastened away to direct the fighting without.

Dejah Thoris and I were left alone. She had sunk into one of the golden thrones, and as I turned to her she greeted me with a wan smile.

"Was there ever such a man!" she exclaimed. "I know that Barsoom has never before seen your like. Can it be that all Earth men are as you?"

"The answer is easy, Dejah Thoris," I replied smiling. "It was not I who did it, it was love, love for Dejah Thoris, a power that would work greater miracles than this you have seen."

A pretty flush overspread her face and she answered,

"You may say that now, John Carter, and I may listen, for I am free."

"And more still I have to say, ere it is again too late," I returned. "I have done many strange things in my life, many things that wiser men would not have dared, but never in my wildest fancies have I dreamed of winning a Dejah Thoris for myself—for never had I dreamed that in all the universe dwelt such a woman as the Princess of Helium."

"He does not need to be abashed who so well knew the answer to his plea before the plea were made," she replied, rising and placing her dear hands upon my shoulders, and so I took her in my arms and kissed her.

Five hours later we sailed from the roofs of the dock buildings with a fleet of two hundred and fifty battleships, carrying nearly one hundred thousand green warriors, followed by a fleet of transports with our thoats.

Behind us we left the stricken city in the fierce and brutal clutches of some forty thousand greedy warriors of the lesser hordes.

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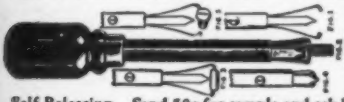

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Carter of the Red Planet

In the middle of the afternoon we sighted the scarlet and yellow towers of Helium, and a short time later a great fleet of Zodangan battleships rose from the camps of the besiegers without the city, and advanced to meet us.

The twin cities of Helium, perceiving that we were friends, sent out hundreds of vessels to aid us, and then began the first real air battle I had ever witnessed.

The vessels carrying our green warriors were kept circling above the contending fleets of Helium and Zodanga, since their batteries were useless in the hands of the Tharks who, having no navy, have no skill in naval gunnery. Their smallarm fire, however, was most effective, and the final outcome of the engagement was strongly influenced, if not wholly determined, by their presence.

At first the two forces circled at the same altitude, pouring broadside after broadside into each other. Presently a great hole was torn in the hull of one of the immense battle craft from the Zodangan camp; with a lurch she turned completely over, the little figures of her crew plunging, turning and twisting toward the ground a thousand feet below; then with sickening velocity she tore after them, almost completely burying herself in the soft loam of the ancient sea bottom.

Within but little more than an hour from the moment the victorious Zodangan squadron had risen to meet us from the camp of the besiegers the battle was over, and the remaining vessels of the conquered Zodangans were headed toward the cities of Helium under prize crews.

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We signaled the flagship of Helium's navy to approach, and when she was within hailing distance I called out that we had the Princess Dejah Thoris on board, and that we wished to transfer her to the flagship that she might be taken immediately to the city.

The flagship bore down upon us, and as she swung gracefully to and touched our side a dozen officers sprang upon our decks. As their astonished gaze fell upon the hundreds of green warriors, who now came forth from the fighting shelters, they stopped aghast.

Dejah Thoris and I then advanced, and they had no eyes for other than her. She received them gracefully, calling each by name, for they were men high in the esteem and service of her grandfather, and she knew them well.

"Lay your hands upon the shoulder of John Carter," she said to them, turning toward me, "the man to whom Helium owes her princess as well as her victory today."

They were very courteous to me and said many kind and complimentary things, but what seemed to impress them most was that I had won the aid of the fierce Tharks in my campaign for the liberation of Dejah Thoris, and the relief of Helium.

"You owe your thanks more to another man than to me," I said, "and here he is; meet one of Barsoom's greatest soldiers and statesmen, Tars Tarkas, Jeddak of Thark."

With the same polished courtesy that had marked their manner toward me they extended their greetings to the great Thark, nor, to my surprise, was he much behind them in ease of bearing or in courtly speech.

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32x4	6.75	2.35	30x4.75	3.05	2.55
33x4	6.85	2.50	31x4.95	4.85	2.50
34x4	6.95	2.50	31x5.00	4.95	2.50
32x4½	8.25	2.75	30x5.25	4.75	2.75
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Carter of the Red Planet

We returned then to the palace of Helium.

At the top of the great steps leading up to the main portals of the palace stood the royal party, and as we reached the lower steps one of their number descended to meet us. He was an almost perfect specimen of manhood; tall, straight as an arrow, superbly muscled and with the carriage and bearing of a ruler of men. I did not need to be told that he was Tardos Mors, Jeddak of Helium.

The first member of our party he met was Tars Tarkas and his first words sealed forever the new friendship between the races.

"That Tardos Mors," he said, earnestly, "may meet the greatest living warrior of Barsoom is a priceless honor, but that he may lay his hand on the shoulder of a friend and ally is a far greater boon."

"Jeddak of Helium," returned Tars Tarkas, "it has remained for a man of another world to teach the green warriors of Barsoom the meaning of friendship; to him we owe the fact that the hordes of Thark can understand you; that they can appreciate and reciprocate the sentiments so graciously expressed."

Tardos Mors then greeted each of the green jeddaks and jeds, and to each spoke words of friendship and appreciation.

As he approached me he laid both hands upon my shoulders.

"Welcome, my son," he said; "that you are granted, gladly, and without one word of opposition, the most precious jewel in all Helium, yes, on all Barsoom, is sufficient earnest of my esteem."

We were then presented to Mors Kajak, Jed of lesser Helium, and father of Dejah Thoris. He had followed close behind Tardos Mors and seemed even more affected by the meeting than had his father.

He tried a dozen times to express his gratitude to me, but his voice choked with emotion and he could not speak, and yet he had, as I was to later learn, a reputation for ferocity and fearlessness as a fighter that was remarkable even upon war-like Barsoom. In common with all Helium he worshipped his daughter, nor could he think of what she had escaped without deep emotion.

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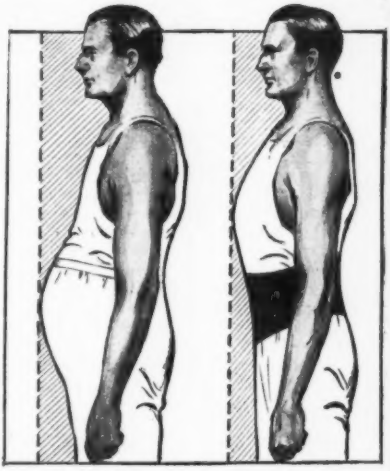

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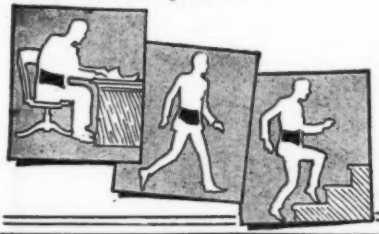

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Carter of the Red Planet

of Helium commanded by Mors Kajak, they started on the return journey to their own lands. The jed of lesser Helium with a small party of nobles accompanied them all the way to Thark to cement more closely the new bonds of peace and friendship.

Sola also accompanied Tars Tarkas, her father, who before all his chieftains had acknowledged her as his daughter.

Three weeks later, Mors Kajak and his officers, accompanied by Tars Tarkas and Sola, returned upon a battleship that had been dispatched to Thark to fetch them in time for the ceremony which made Dejah Thoris and John Carter one.

(THE END.)

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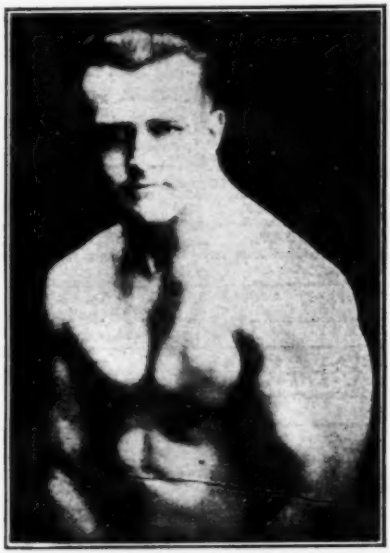

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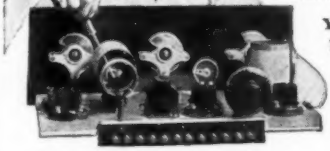

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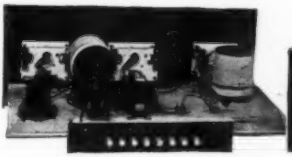

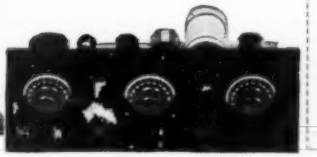

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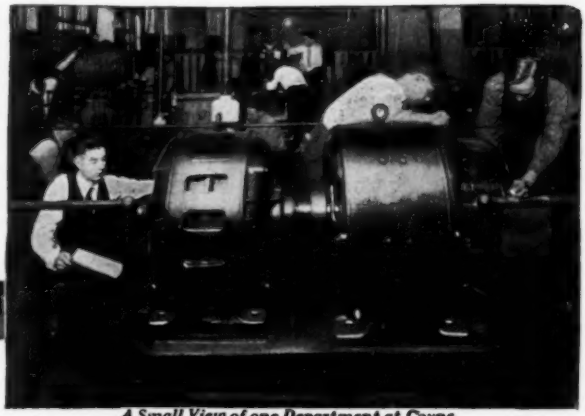

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